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May 2015
Issue 415

GUIDE TO TODAY'S TECH

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Create your perfect PC!

INTEL'S BROADWELL

In-depth look at the game-changing tech powering new PCs, laptops and tablets

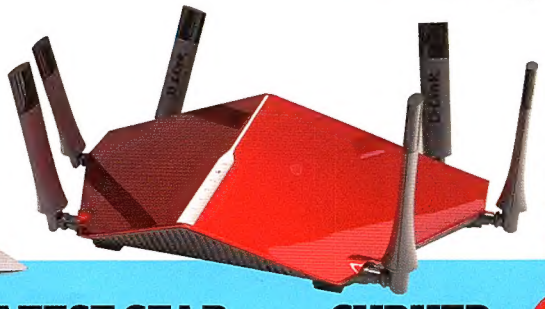
GEFORCE GTX TITAN X

Is Nvidia's $1,600, 12GB gaming card actually worth the ludicrous price?

TECH EXPERTS' TOP SECRETS

MASTER YOUR PC & GADGETS! ESSENTIAL TECH KNOW-HOW FOR:

PC UPGRADES, TROUBLESHOOTING & MAINTENANCE ■ WINDOWS ■ MAC ■ LINUX ■ ANDROID ■ iOS ■ BATTERY LIFE ■ NETWORKING ■ STREAMING & DOWNLOADS ■ SECURITY & PRIVACY



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- Secure your surfing with a Rasp Pi and Tor
- Control your Mac with gestures
- Oversee and control your home network

LATEST GEAR LABS TESTED

- Brand new 500GB & 1TB Crucial SSDs
- Lenovo's sexiest ThinkPad ever
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PC GAMER EDITOR'S CHOICE ★★★★★

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The next Samsung

APC's editor weighs the pros and cons of the rise of the Chinese tech giants.

China has long been the electronics world's manufacturing powerhouse, but the designs for those tech products have largely come from the west, Korea or Taiwan. All that's radically shifted in the last few years, however, with the smartphone and tablet era powering the rise of some gargantuan Chinese electronics companies.

While most followers of the tech sphere will have heard of companies like Foxconn – one of the main manufacturers of Apple's iPhone (and many other smartphones) – few of us have heard names like Xiaomi, ZTE, Oppo and Huawei.

But perhaps it's time to take notice. These are now some of the biggest sellers of smartphones in mainland China – Xiaomi, in particular, is beating both Apple and Samsung for smartphone sales in its homeland, and came in at number three worldwide for total handsets sold in 2014.

The rise of China obviously hasn't been a sudden or perhaps unexpected phenomenon. Lenovo, the Chinese tech giant that absorbed IBM's PC division back in 2005, has gone on to become the world's biggest computer maker, a position that it's held for several years running.

That's not to suggest there haven't been teething problems with the rise of Chinese tech. Lenovo was recently in the spotlight for preinstalling adware on some of its PCs – adware which also happened to be so badly designed that it exposed users secure internet traffic and put them at risk of being hacked.

And on the subject of hacking, western governments around the world have been wary of Chinese tech, fearing that it will provide backdoors for Chinese government snooping. However, a recent UK-government backed investigation of Chinese giant Huawei, whose products are used in a huge swathe of communications products (from consumer devices to enterprise networking and internet infrastructure), found that the company's products did not pose a threat to the nation.

That's good news for companies like Oppo and ZTE, which are making tentative steps into the Australian smartphone market. It probably isn't a matter of 'if' you'll own a Chinese-branded smartphone, laptop or tablet in the future, then, but when. ■

DAN GARDINER
EDITOR-IN-CHIEF
dan.gardiner@futurenet.com

apc

Future Publishing Australia,
PO Box 1077, Mount Street, North Sydney, NSW 2059
Tel: 02 9955 2677 Fax: 02 9955 2688
SUBSCRIPTION ENQUIRIES: Please call Magshop 13 61 16
Email: apcmag@futurenet.com
Web: www.apcmag.com

EDITORIAL
Editor-in-Chief **Dan Gardiner**
Managing Editor **Melanie Pike**
Journalist **Joel Burgess**
Journalist **Stephen Lambrechts**

ART/PRODUCTION
Creative Director **Troy Coleman**
Senior Designer **Nykke Coleman**
Designer **Sharnee Brisbourne**

CONTRIBUTORS
Matt Bolton, J. R. Bookwalter, Simon Crisp, Dan Griliopoulos, Dave James, Cliff Joseph, Jeremy Laird, Christopher Livingston, Ashton Mills, Nick Peers, Matthew JC. Powell, Mayank Sharma, Alan Stonebridge, Nathan Taylor, Luis Villazon, Sam White, Tyler Wilde, Darren Yates

SENIOR MANAGEMENT
Chief Operating Officer **Neville Daniels**

COMMERCIAL
Sales Director Paul Marttila
paul.marttila@futurenet.com

Senior Sales Manager Jairo Manzoupo
jairo.manzoupo@futurenet.com

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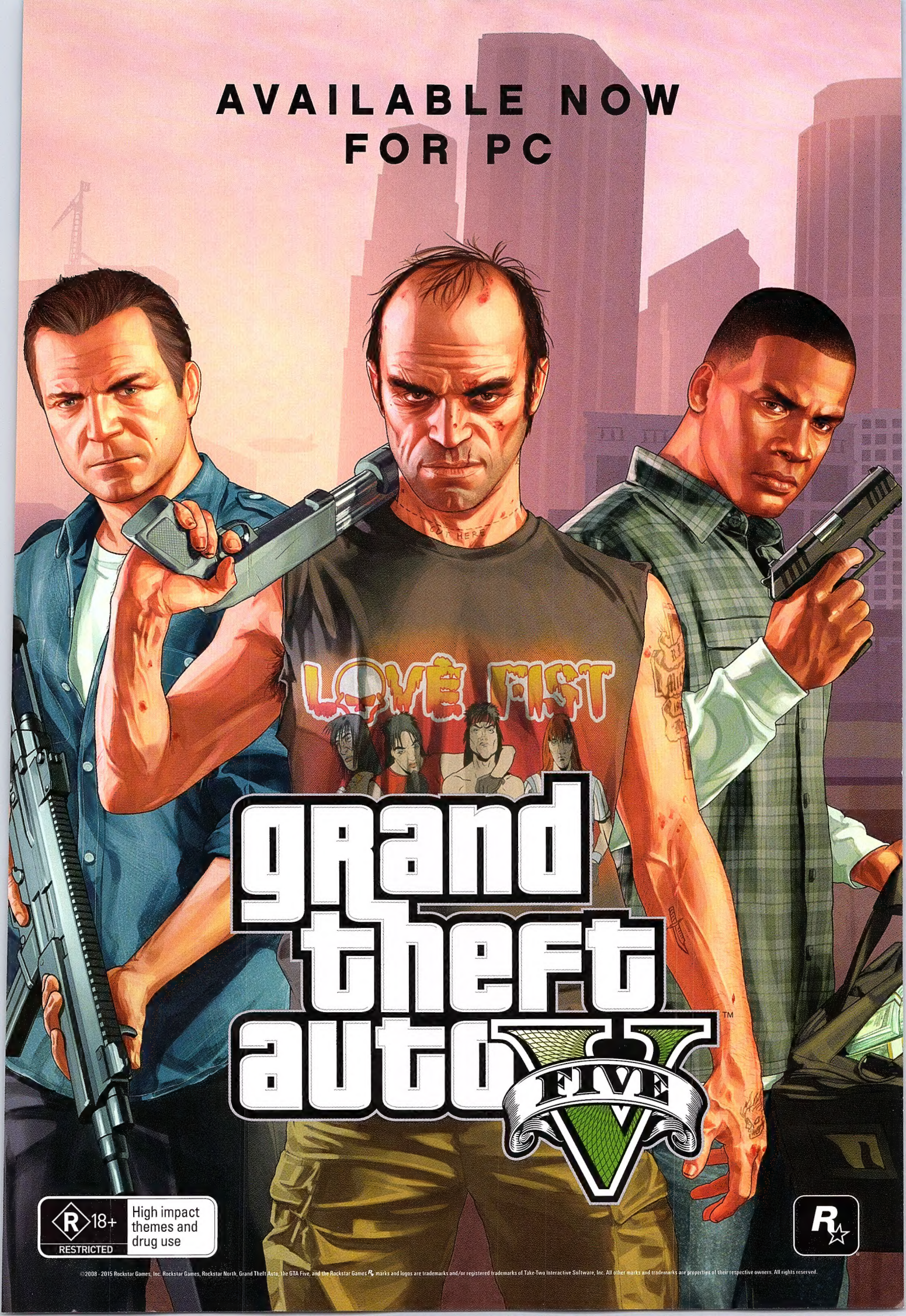

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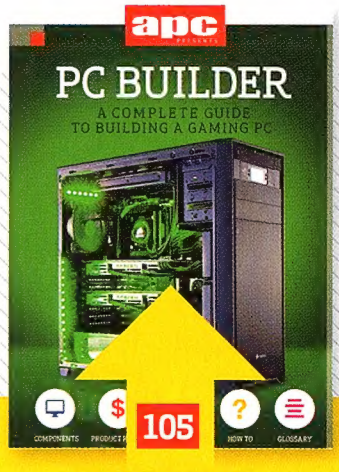

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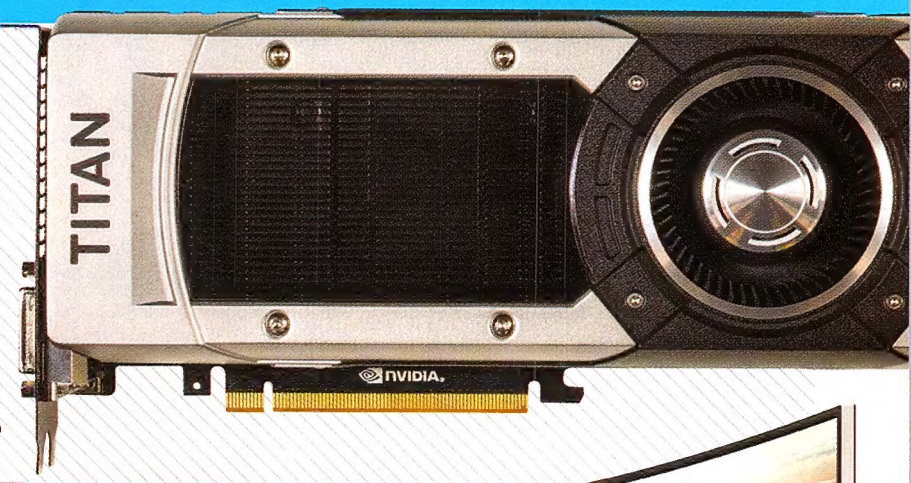

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technotes

» NEED TO KNOW

Web filtration on the table... again

Australian Govt. bill aims to block access to copyright-infringing sites.

Despite recent steps by the Australian government to help establish agreed-upon industry codes around illegal downloads – which will see ISPs and entertainment rights-holders sharing the cost of warning (and eventually punishing) users for downloading copyright-infringing content – there's a definite feeling that the government doesn't think these codes go far enough to curb the problem.

On March 26th, Communications Minister Malcolm Turnbull introduced the new Copyright Amendment (Online Infringement) Bill, which aims to mandate that ISPs block web sites that are 'primary' sources for downloading free copyrighted material. The bill pertains wording that means it will encompass BitTorrent indexing sites that do not directly host infringing content, but which provide links allowing users to access this content. Enforcing these measures will cost the industry an estimated total of $130,825 per year, but the bill noted that any site block that was challenged by the internet providers would incur further legal costs. The legal parameters of imposing filters on the internet has been a contested topic in Australian politics for many years, and opponents of the bill such as Dr Matthew Rimmer, an associate professor at ANU College of Law, believe that the scope of the proposed laws open the door for the blocking of other web sites that arguably benefit the broader public.

Joel Burgess

The Pirate Bay dodges ISP blocks

Torrent site keeps finding ways to stick it to the man.

Say what you will about notorious torrenting site The Pirate Bay, but you can't say that the people behind the scenes aren't persistent. Late last year, the site was taken down by Swedish authorities, yet a month and a half later, The Pirate Bay was back in force and stronger than ever with CloudFlare support. Now, an unexpected benefit has resulted from the team-up.

The Pirate Bay originally enlisted CloudFlare's help to deal with large amounts of traffic upon the site's return, but a surprise side effect has made it possible for the site to circumvent ISP blocks. CloudFlare manages the data transferred between the site's users and hosting servers to protect both from DDoS attacks. Because of CloudFlare's ability to remove the HTTP header from HTTPS connection requests when properly configured, it's now possible for The Pirate Bay to elude an ISP's list of banned sites. Site access has now been restored to BT, EE, Virgin, Sky and TalkTalk customers in the UK, which was previously blocked by a government blacklist.

Stephen Lambrechts

Steam Controller gets a release date

And it's bringing a Steam Link streaming box in tow.

After what seems like an eternity of waiting, Valve has finally announced a price and a tentative release month for its innovative Steam Controller. You'll be able to get your hands on the touchpad-laden controller when it arrives in November. It won't cost you an arm and a leg, either — the Steam Controller will only set you back US$50.

Valve also announced a completely new product — introducing the Steam Link, a cheap and small micro PC that doesn't actually play games, but is dedicated to helping you stream games across your network in tandem with Steam-in-home-streaming. It is also slated to arrive in November and will also only cost US$50. It seems Valve really likes that date and price!

Finally, Valve announced something else that people have been eagerly anticipating — Source Engine 2 is officially in the works. Whether or not that means we'll finally get a new *Half Life* installment to go along with the engine is a matter of speculation at this point.

Stephen Lambrechts

Cheaper Atom-powered Surface 3 arriving

A cheaper, lighter alternative to the Surface Pro 3.

With the release of the Surface Pro 3, Microsoft finally delivered a tablet-hybrid that connected with its intended audience in a big way. In doing so, it avoided releasing a pared-down RT equivalent alongside it, leading many to wonder if the company would be unveiling a cheaper Surface 2-successor at all. Well wonder no more, as Microsoft has officially announced the lighter and less expensive Surface 3 — best of all, it runs a full version of Window 8.1, not Windows RT.

The Surface 3 will arrive in two iterations — a $699 version with 64GB of SSD storage and 2GB of RAM, and an $839 version with 128GB of SSD storage and 4GB of RAM. Both will come with a 1.6GHz quad-core Intel Atom x7-Z8700 processor, and a 10.8-inch 1080p screen, as well as a one-year subscription to Microsoft Office 365. Pre-orders for the Surface 3 are now open on Microsoft's online store, with an estimated delivery date of May 5. **Stephen Lambrechts**

NETFLIX

EU seeks to kill regional limits

The European Commission proposes to end geo-blocking.

The European Commission had its first meeting surrounding a Digital Market Strategy in March, which aims to break down international barriers for online businesses operating within the EU. The discussion identified a number of issues as major roadblocks to a unified online EU, including geo-blocking, inefficient cross-border parcel deliveries and unconnected e-services. Facilitating better access to online goods and services, establishing an environment that nourishes digital businesses and creating a digital economy within the EU are the three focal points of a report that the European Commission will present in May. Details on the specific regulations that will enforce this digital market are yet to be released, but the general outline suggests that consumers shouldn't be forced to use country-specific services, like those currently offered by the subscription streaming industry. Whether or not these regulations actually become legislation is not a given, however, but it could be an important step in opening up the current regional limits on content that are being imposed by the entertainment industry. Joel Burgess

Windows 10 to send Linux into exile?

Microsoft's next OS might stop hardware from booting alternate OSs.

Microsoft announced in March that unlike Windows 8, hardware that ships running its next operating system will not have to include an 'off switch' for the UEFI Secure Boot feature. Secure Boot is intended to protect computers from malware that runs before the OS has had a chance to load by checking the signatures of programs that are told to run in the boot phase — including the OS itself. Because computers with secure boot loaders are shipped with a finite set of keys, if the OS bootloader you want to run isn't on that list — and many Linux bootloaders aren't — the UEFI simply won't run it — and without an off switch, it never will. **JB**

'Licence to look'

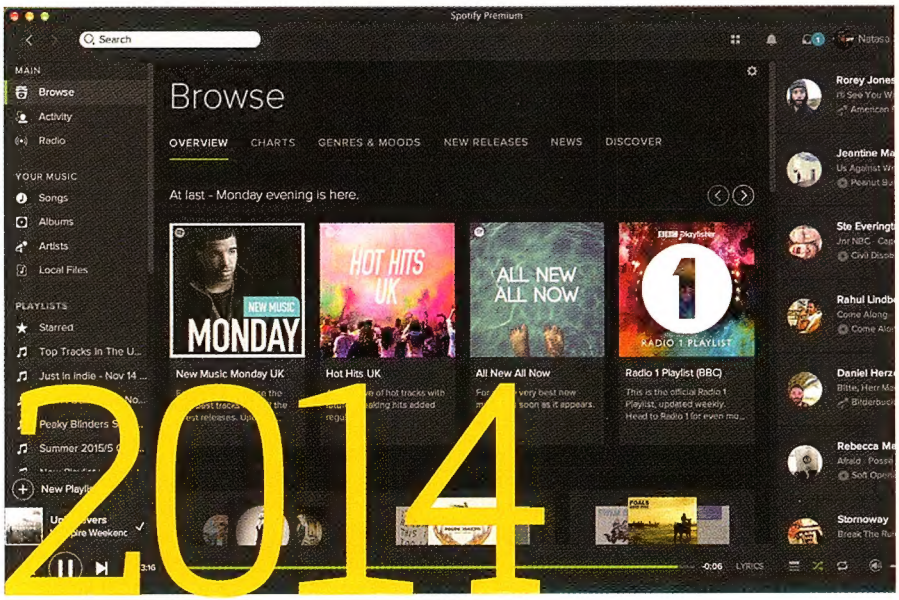
UK government states it has authority to hack anyone's computer for any reason.

The UK government, in an 'open response' regarding a court case against its intelligence agency GCHQ, has reportedly stated that the security organisation has the broad authority to "hack anyone, anywhere in the world, even if the target is not a threat to national security nor suspected of any crime", according to one of the plaintiffs, Privacy International. **JB**

Windows 10 free-for-all

Keep your friends close and enemies closer: pirates welcomed by Microsoft.

Microsoft has revealed that the free upgrade to Windows 10 OS will be available to any Windows 7 or 8.1 user — regardless of whether they are running legitimate software or not. Microsoft's operating systems chief Terry Myerson told Reuters at the WinHEC conference in China, "We are upgrading all qualified PCs, genuine and non-genuine, to Windows 10." There is a catch, however: Microsoft told Ars Technica that if users upgrading from a pirated OS will be slapped with a 'Non-Genuine' version of Windows 10, which will prompt users to purchase a valid OS license. **JB**



2014

THE YEAR STREAMING FINALLY OUTPACED RETAIL MUSIC SALES.

Last year, music CD sales generated a hefty US$1.85 billion in revenue, but for the first time music streaming services managed to take a bigger slice of the pie — just — generating US$1.87 billion. The new all-you-can-eat services like Spotify, Pandora, Beats and Milk are believed to be having an impact on established online music outlets like the Apple iTunes Store — for which revenue fell by 8.7% last year. The iTunes Store still posted the largest music revenue overall last year, however, ringing in with US$2.57 billion.

910 DAYS

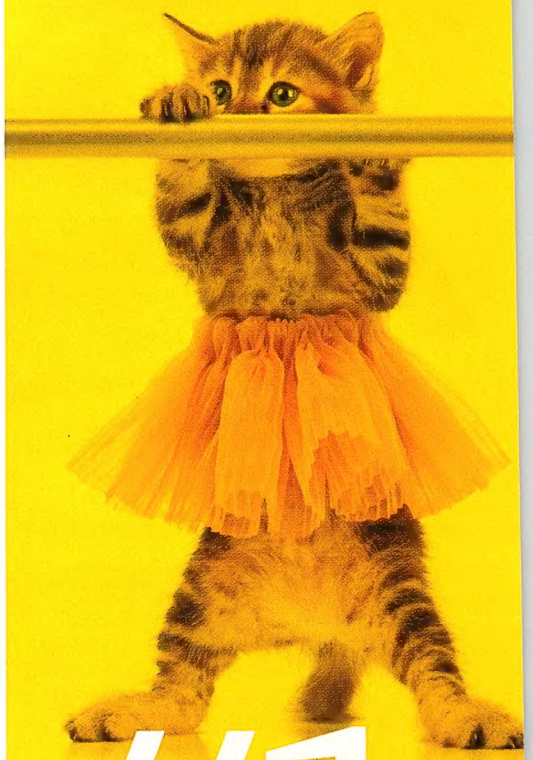
AND YOU THOUGHT APPLE'S GOLD WATCH WAS EXPENSIVE IN AUSTRALIA...

In China, its country of manufacture, the entry-level gold Apple Watch Edition costs 74,800 yuan, or roughly US$11,000. The base wage of an assembly-line worker at Chinese manufacturer Foxconn (possibly one responsible for building the new Apple smartwatches) is 30,000 yuan per annum. If said worker spent nothing on food, paid no taxes and saved every yuan they earned, it would take more than two and a half years to accumulate enough to afford an Edition watch. The same feat would take Apple's CEO Tim Cook 48 hours on his base salary.

11 million

NUMBER OF EXPOSED RECORDS FROM HEALTH INSURER DATA BREACH.

US health insurance company Premera Blue Cross has revealed that customer data stored on its servers — including clinical history, bank account numbers, social security and birth dates — was compromised when hackers obtained access to its 11 million personal account records in March. This is the second data attack on a US health insurance company this year, following a breach of Anthem Inc. in February that saw 70 million files stolen.



#1

CAT GIFS TAKE A BACK SEAT TO MORE MUNDANE TASKS.

Paying bills and online banking were the most common activities performed on a home internet connection in 2013, according to recent data released by the Australian Bureau of Statistics. More than 70% of Australians using the internet engage in online banking and pay bills using the web. Outnumbering the 65% of internet users that use the web for social media, it seems the web for Australians is primarily a mundane admin interface for counting our pennies and giving the Man his dues.

35%

AUSSIE DATA CONSUMPTION ON THE RISE.

Between the end of 2013 and 2014, Australian fixed broadband users downloaded 35% more data than the previous year, according to data from the Australian Bureau of Statistics. That added up to a total of 2 million terabytes of data (or 6.3 billion CDs) — an impressive feat considering less than 20% of Australian broadband users have speeds over 24Mbps.

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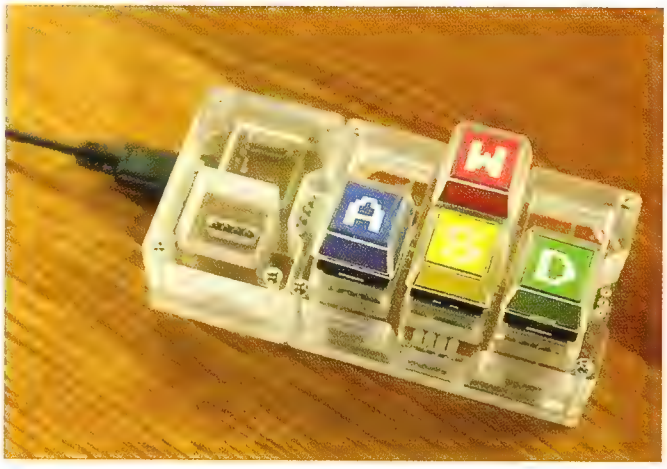
» GEAR WE WANT



TRICKEY

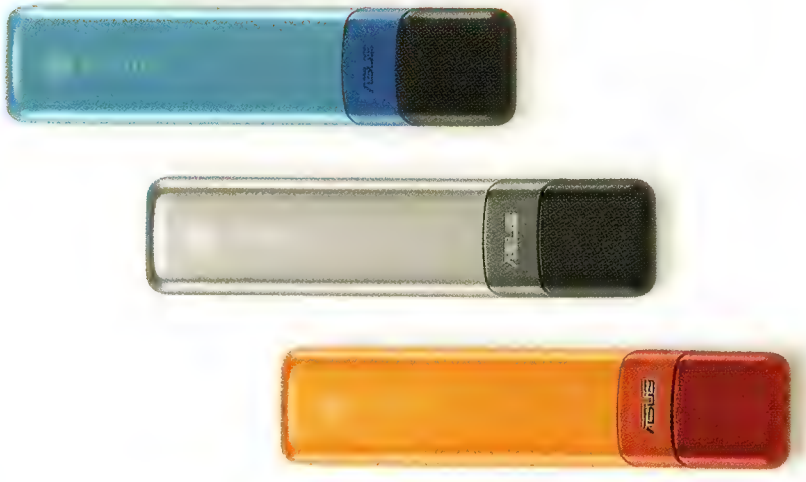
US$139 | TINYURL.COM/APC415-TRICK

Ever wished you could add a key to your keyboard? Trickey may be the answer. With a little over half of the required Kickstarter funding goal at the time of writing, this fully customisable and expandable keyboard unit could really take off – though we wish it were a little bit cheaper. Not only can you arrange and assign functions to each key in the 2 x 3 format, but each unit can also be fastened and connected to one another. Working in conjunction with existing keyboards, the Lego-like Trickey can be used as an additional hotkey hub or simply as a stand-alone custom keyboard. You can even design your own labels for keys and print them out. **Joel Burgess**

ASUS CHROMEBIT

$TBA | WWW.ASUS.COM/AU

Google has unveiled its smallest ChromeOS computer yet – introducing the ASUS Chromebit, a fully functioning stick PC that lets you run the browser-based OS on any screen with a HDMI slot. Best of all, it'll apparently cost around a hundred bucks. It features a Rockchip RK3288 processor, quad-core Mali 760 graphics, 16 GB of SSD storage, 2 GB of RAM and is Wi-Fi and Bluetooth capable. It also has a USB 2.0 port. While it faces stiff competition from the recently announced Intel Compute Stick, we reckon the ASUS Chromebit is going to be hard to beat. **Stephen Lambrechts**



THE IDRINK

PRICE/WEB TB IDRINKUSA.COM A

Here's a product that both encourages and dissuades your alcoholism – introducing The iDrink, an iPhone case with a built-in breathalyser, bottle opener, taxi hailer and tie-in video game. It even runs off its own battery!

While not at all FDA-endorsed or legally admissible in a court of law, the iDrink claims to read a user's blood alcohol content (BAC) in conjunction with the iDrink app, accurate to within 5-10%. The app also includes a driving minigame which changes difficulty based on your intoxication level, so you can keep entertained while you wait for your cab to arrive.

Stephen Lambrechts

YEELIGHT BLUE II & BLUE LIGHTSTRIP

BLUE II, $59.95; BLUE LIGHTSTRIP, $69.95 | WWW.YEELIGHT.COM.AU

There's a growing number of 'smart' light bulbs on the market these days, but these Yeelights take a slightly different tack than most, aiming to be inexpensive little units that deliver all the basics you likely need. They're Bluetooth controlled via Android or iOS smartphone apps – meaning you can't tie them into a larger home automation set up like the Wi-Fi Philips' Hues or Belkin's Wemos – but you can still do things like adjusting overall brightness in 1% increments, changing colour and setting automatic on/off times (including the ability to match sunrise and sunset). There's also a disco mode that randomly changes the colour – which works quite well with the lightstrip model... in short bursts, if you want to maintain your sanity. If you want colour-adjustable smart lights but don't need all the frills (or the associated $150 price tag) these get the job done. **Dan Gardiner**

POWERSHADE

US$289 | WWW.POWERSHADE.CO

Days at the beach are great, until your iPhone battery runs out and you have to stop posting pictures on social media and revelling in other people's jealousy. Or maybe that's just us. Still, that problem could be solved by the PowerShade, a beach umbrella covered in solar panels. There are two USB ports and even an AC socket on the pole, so you can keep a Kindle, iPad or wireless speaker charged. PowerShade's creators say that with clear, strong sun, it should charge devices at the same speed as a normal outlet. It's on Kickstarter as we go to press, due for a June delivery.

HACKABALL

US$89 | WWW.HACKABALL.COM

Teaching kids logic and programming through games is nothing new, but this Kickstarter may be one of the coolest ways to do it yet. It's an actual ball – made of tough stuff so it can be thrown around – full of LED lights and sensors. The idea is that kids can come up with ways Hackaball can be used in games, and then program it themselves, using an intuitive iPad app. Maybe it's a bomb that "explodes" by rumbling and lighting up at a certain time; maybe it's a pet that makes noise when moved too harshly... it's up to them!

Prepare to deal with adhesive as strong as you're likely to find in a tablet.

Google Nexus 9

Be prepared for extra-tough adhesives.

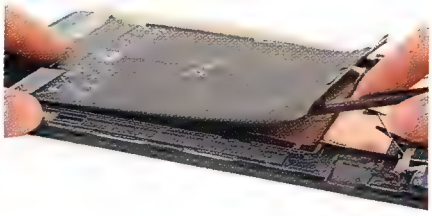
A commodity-spec Android tablet for the mouth-breathing masses? Yuck. But wait. It packs one of Nvidia's new Tegra K1 chips, the version with Nvidia's special-sauce Denver cores. Intriguingly, the Denver variant has just two cores compared to the quad-core version that's based on ARM A15 CPU cores. So that's two K1s with different core counts and architectures. Baffling and fascinating? You betcha.

MAJOR TECH SPECS

- 8.9-inch IPS LCD with a resolution of 2,048 x 1,536
- 64-bit Nvidia Tegra K1 dual-core processor running at 2.3GHz, paired with a 192-core Kepler GPU
- 2GB RAM
- 8MP f/2.4 rear-facing camera + 1.6MP front-facing camera
- 802.11ac 2x2 (MIMO) Wi-Fi, Bluetooth 4.1, NFC
- 16 or 32GB on-board storage
- Android 5.0 Lollipop

KEY FINDINGS

- The Nexus 9 is marketed by Google, but it's an HTC-built tablet (no doubt with design input from the former). Anyway, the rear cover is held on with clips, not fierce adhesive. Huzzah! No tools are needed to pop it off, just sturdy fingernails. This is where the disassembly good news ends though.
- We scan for additional things to shake our spudger at. A bit of gumshoeing turns up what appears to be the NFC antenna. Our teardown fingers peel it apart from the rear case.
- The battery is within our reach, but not our grasp: some fairly heavy-duty adhesive holds it fast in place. Fortunately, we're equipped. A quick visual inspection verifies Google's official specs, with a rating of 3.8V, 6,700mAh, and 25.46Wh.



At 6,700mAh, the glued-on battery is squarely between the iPad Air 2 and iPad Mini Retina Display.

- Prominent chips include some Elpida/Micron Technology RAM (2GB), 16GB of Samsung NAND Flash, a Broadcom 5G Wi-Fi 802.11ac/Bluetooth 4.0/FM Module, (deep breath) and a Broadcom Integrated Multi-Constellation GNSS Receiver.
- Can we separate the LCD from the display assembly? Yes. But it requires an insane amount of heat, patience, and prying. This is some of the toughest adhesive we've ever met in a tablet — on par with the infamous Surface Pro.
- Nexus 9 Repairability: 3 out of 10 (10 is easiest to repair). The rear case can be easily removed without heat or tools (just don't lose your rear-facing camera). The battery is easy to get to, but glued in place. Thankfully, heat isn't required. Inside is a maze of tape and thin cables, making disassembly and reassembly difficult and perilous. The LCD is fused to the front glass, so you'll need to replace both components if your screen is cracked. Finally, the display glass is insanely and solidly glued to the midframe, making the replacement difficult unless you can source the whole assembly. ■

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit **www.ifixit.com**.

technotes

› EPINIONS

WHEN IS FREE NOT FREE?

I have to laugh at your headline "Windows 10 will be free". GNU (**www.gnu.org**) describes free software as: "A program is free software if the program's users have the four essential freedoms: The freedom to run the program as you wish, for any purpose (freedom 0). The freedom to study how the program works, and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this. The freedom to redistribute copies so you can help your neighbour (freedom 2). The freedom to distribute copies of your modified versions to others (freedom 3). By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

A program is free software if it gives users adequately all of these freedoms. Otherwise, it is nonfree. While we can distinguish various nonfree distribution schemes in terms of how far they fall short of being free, we consider them all equally unethical."

So Windows 10 will not be free! Microsoft simply has decided to not charge a fee for the first year. On the second and subsequent years you must pay an annual license fee!

By any reasonable definition this is not free but an extended free trial period. Hardly revolutionary.

What happens after 12 months should you decide to return to Windows Vista, 7, 8 or 8.1?

For my part I refuse to pay an annual license fee for Microsoft Office 365 and will not be suckered into the same with Windows 10. Rather than seeing this as an altruistic act of contrition for Windows 8/8.1 it could be seen as a canny way of: a) ensuring an annual income stream, and b) locking licensees into Windows 10 and Office 365 in future.

> "I see its current tactics simply as an expedient avenue to find other ways to lock out the competition and maintain its traditional monopoly."

I have felt Microsoft's influence with my new HP Pavilion desktop. UEFI is forced upon me because I cannot install Windows 7 or dual boot Ubuntu without voiding my warranty – or at least that is how it appears from HP's start screen and web site. And if I do implement BIOS I loose the ability to run my copy of Windows 8/8.1 as it is locked into UEFI.

I also stupidly bought a Surface 2. Microsoft has dumped this without any ceremony. They only market the expensive Pro now – but I wonder for how much longer?

Although I have long been a Microsoft champion, since Vista this company has lost sight of its customers. I see its current tactics simply as an expedient avenue to find other ways to lock out the competition and maintain its traditional monopoly. I no longer trust Microsoft to act in anyone's interests other than its own. How power corrupts!

Ian Hollis

Ed replies: While it's undeniably true that Windows 10 won't be 'free' in anywhere near the same sense as say, General Public Licensed software like Linux, it will be available as a free upgrade for users of Windows 7 and 8. The one catch is that you only have 1 year after Windows 10's release to take advantage of this free upgrade offer. However, that doesn't mean Microsoft will be charging a subscription fee after that year is up — and the Redmond company has taken pains to make that clear. A post on the official Windows Blog on January 21, 2015 states that "...once a Windows device is upgraded to Windows 10, we will continue to keep it current for the supported lifetime of the device — at no cost."

Microsoft has signalled that it does eventually want to move to a 'Windows as a service' business model for its OS — so it is probably wise to be wary and check the fine print — but Windows 10, at least the edition offered as a free upgrade, won't be it. ■

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No more secrets

Australian internet users are now being watched, as controversial data retention bill passes through parliament. Stephen Lambrechts

The Telecommunications (Interception and Access) Amendment (Data Retention) Bill 2014 has been passed, backed by both the upper and lower houses of parliament. The new law requires telecommunications companies and ISPs to store your private data for two years, so that security agencies can comb through it all to see if you're a terrorist.

The legislation requires security agencies to have a warrant to access the metadata of people with certain professions, like journalists, due to the life-threatening impact that leaked information could have on them and their contacts. Almost everyone else, though, is out of luck – law enforcement agencies have will warrantless access to your metadata.

So what exactly can they see? Under the bill, government agencies now have access to information about who you call, the duration of your calls, where you were when you made the calls, email addresses you've contacted, the times of sent messages, your IP address, your download and upload volumes and information about your communications equipment, including where it's located.

Thankfully, the legislation excludes giving agencies open access to your web browsing and search history, as well as the actual content of your emails and phone calls. That's not to say the info isn't being collected or that security agents won't be able to get access to it – they'll just need a warrant to do so.

There's been a huge amount of criticism levelled at the bill, specifically around the government's inability to deliver a clear cost projection for it (estimated at close to $400 million per year), as well as the bill's unconstitutional lack of independent oversight, allowing invasive searches of data without consultation of a judge. There's even been speculation that it will actually cost you money at an ISP level – we could end up paying up to $5 per month, or $60 a year, to let the government surveil us. (It's a bit like being forced to say 'thank you' to a mugger... but we digress.)

While various countries in the European Union have adopted data retention laws, many of them have come under fire, including in the United Kingdom, where civil rights campaigners have placed a legal challenge on the act on behalf of two British MPs. Other countries are even backpedaling on their data retention schemes – Germany has completely abandoned its laws after it was found that they weren't particularly useful for solving or preventing crimes.

Most countries with data retention laws will only hold on to the metadata for around six months to a year, unlike the two years in Australia's version of the bill. The more data that is collected, the more of a security risk to personal privacy it poses. Which brings us to another concern – the legislation in Australia is unclear on who will have access to the data, whether it will be stored here or off-shore and how it will be encrypted.

So what can you do to avoid data retention? For starters, read 'Why you need a VPN' (*APC* 412), in which we review a range of services that will hide your data online. You could also use secret encrypted messenger apps like Wickr – we hear Minister for Communications Malcolm Turnbull is a pretty big fan of that one... ■

ENDUSER

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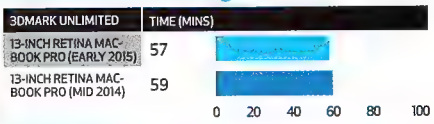
apc HOT PRODUCT

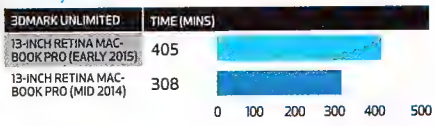
LABS BENCHMARK RESULTS

To test real-world CPU capability, we re-encoded a Blu-ray quality video. Lower numbers are better. To test battery life, we set the screen brightness to 50% and stream web video until the battery runs out. Higher numbers are better.

Handbrake video encoding test



Battery life test



LAPTOP

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Apple 13-inch MacBook Pro with Retina display

The Force Touch is strong with this one.

A new trackpad isn't much of an upgrade for a laptop. While the new 13-inch Retina Pro also has an updated processor to boast of, along with improved graphics, that's it for changes. Arguably though, that's all it needs. It was already one of Apple's best machines, offering more than enough speed for most people along with a Retina screen for a good price.

We'll come to the CPU and GPU later, but the Force Touch trackpad is the thing you'll play with most at first, because it's frankly fascinating. Old trackpads have a hinge at the back, and when you click the trackpad, you push down on the hinge. The pad physically moves. On the new trackpad, it doesn't move — yet it feels as if it clicks beneath your fingers. There's a small electromagnetic motor inside, and when it detects the pressure of your finger, the motor creates a click.

While that's all cool, it's not exactly a useful change in itself. But the Force Touch trackpad adds extra functionality over the old style of trackpad. You've still got multi-touch gestures, but it's also now pressure sensitive, capable of registering presses of different strengths. If you click on something, then keep pressing harder, you get a second click from the trackpad, and something different will happen — replacing the long click of old in some places, such as the Dock. In QuickTime Player, the harder you press, the faster the fast-forward option goes. In Preview, when signing your name, it can detect your drawing pressure. It's another way of interacting, and it's a nice addition, but we do think Apple could have implemented it better. The main issue is that, though you can make use of it in all sorts of places around OS X, it's not always obvious what it will do. For example, "Force click" (in Apple's parlance) on a file's icon and it opens it in Quick Look, but Force click on the file's name and it makes the name editable. These two things don't share any common factor (such as a keyboard shortcut), yet you can invoke them both by moving the cursor just a few pixels on one file.

Some of Force Touch's most impressive use is in pure feedback, such as in iMovie. When a clip snaps to a point on the timeline, for example, you get a jolt from the trackpad to indicate that it has snapped. It's a lovely little touch, and we hope many developers will make use of it and the pressure sensitivity.

So what about those few other changes? The processor is indeed a small difference, offering an improvement of less than 10% in our Cinebench benchmarks. Still, it offers fantastic improvement in a different area: battery life. In our intensive video streaming test, the new machine lasted 6 hours and 45 minutes, hugely surpassing the older version's 5 hours and 8 minutes.

Sadly, the new Intel graphics haven't delivered much of a performance improvement.

Not be a big leap forward for the MacBook Pro then, but if you're looking at a Mac laptop now, this offers the best balance of power, features, portability and price. ■ **Matt Bolton**

Verdict

Features ★★★★½
Performance ★★★★
Value ★★★★

The performance updates are minor, but the Force Touch trackpad is a great new addition.

★★★★½

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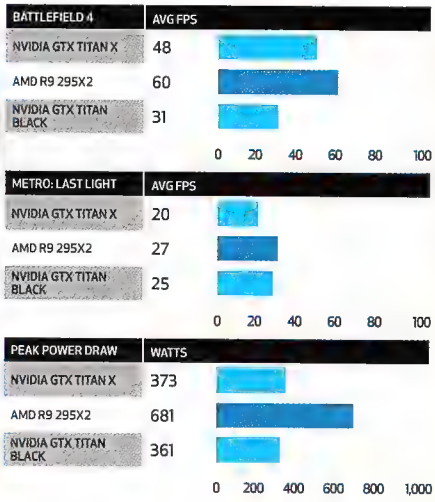
LABS BENCHMARK RESULTS

All the gaming tests were carried out with ultra settings at 3,840 x 2,160. Our test bench is a stock-clocked Core i7-4770K in an ASUS Maximus Hero Z97 motherboard with 8GB Corsair Dominator DDR3 @2,133MHz.


BATTLEFIELD 4
AVG FPS
NVIDIA GTX TITAN X 48
AMD R9 295X2 60
NVIDIA GTX TITAN BLACK 31
0 20 40 60 80 100
METRO: LAST LIGHT
AVG FPS
NVIDIA GTX TITAN X 20
AMD R9 295X2 27
NVIDIA GTX TITAN BLACK 25
0 20 40 60 80 100
PEAK POWER DRAW
WATTS
NVIDIA GTX TITAN X 373
AMD R9 295X2 681
NVIDIA GTX TITAN BLACK 361
0 200 400 600 800 1,000

Nvidia GeForce GTX Titan X

The full might of Nvidia's Maxwell architecture brought to bear with this titanic new GPU.

Nvidia has maxed out its Maxwell architecture and the result is the GeForce GTX Titan X.

What we do have here is a brand spanking new 'ultra-enthusiast', super-expensive graphics card. Like all the other Titan cards Nvidia has released over the last three years, this is a card for gamers simply looking to get the best gaming experience possible and hang the fiscal sense of it. But it's also a card designed more to be an object of desire, an aspirational piece of hardware, than something most of us normal PC gaming folk are likely to buy in our droves.

The beating heart of the Nvidia GeForce GTX Titan X is the brand new GM 200 GPU at its core – it's the biggest GPU core around, packing in 50% more processing tech than the GM 204 silicon in the GTX 980.

That massive GPU contains a full 3,072 CUDA cores and around eight billion transistors. Putting that in context, the GTX 980 has almost three billion fewer transistors.

But chances are there's another number which has peaked your interest surrounding the Nvidia GeForce GTX Titan X – that's the enormous 12GB frame buffer. Running across the same aggregated 384-bit memory bus as the original Titan cards, but including Maxwell's fancy new memory compression algorithms, its memory configuration is there to provide a welcome level of future proofing to Nvidia's top consumer GPU.

Those 12,288 megabytes of speedy GDDR5 memory might look like overkill now, but back when the first Titan hit the desktop its 6GB frame buffer looked stupidly large. And now we've got *Shadow of Mordor* filling 5.7GB with its hi-res texture pack at 4K.

The Nvidia GeForce GTX Titan X can't actually call itself the fastest gaming graphics card available right now, however. That's all down to the continued impressive performance of AMD's R9 295X2 card.

The AMD Radeon R9 295X2 is still the fastest graphics card in terms of gaming, offering higher average frame rates in the latest titles at 4K resolutions. And if average frame rates were the whole story you could happily conclude that the cheaper AMD card is a better choice.

But they're not. The Radeon is able to achieve its performance with its last-gen, soon-to-be-second-tier GPUs, because it's using two of them to power one card. It's a CrossFire setup on a single slice of PCB. That's impressive, but it introduces a whole host of problems that the resolutely single GPU Titan X doesn't have to worry about.

The Titan X only requires a 600W PSU, while the R9 295X2 realistically needs a 1,000W job. That energy requirement also means it demands a closed-loop water cooler to run at its rated speeds. Then there are the vagaries of multi-GPU gaming. In short, it's tough to trust twin GPUs to always deliver the performance you've paid for.

In short, the Titan X is the fastest single GPU card in an elegant, efficient package. So yes, if money's no object then fill your boots with this powerful, pricey graphics card. But if it is, don't worry. There will be a more reasonable GM 200-powered card rocking up before the end of the year, we're sure.

Dave James

Verdict

Features	★★★★½
Performance	★★★★★
Value	★★★

Impressive 4K gaming performance; efficient high-end GPU; stays quiet; overclocks like a boss.

★★★★

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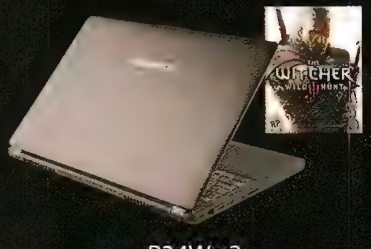
GEFORCE GTX 970M

P35X v3
GEFORCE GTX 980M

P35W v3
GEFORCE GTX 970M



P34W v3
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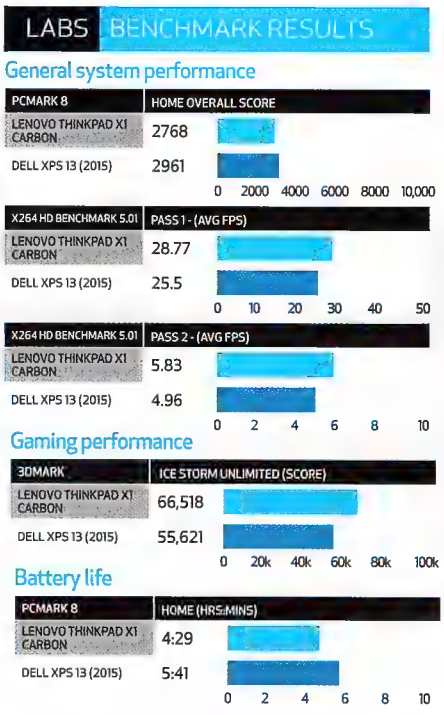

Lenovo ThinkPad X1 Carbon

Lenovo makes the business laptop a looker.

The X1 Carbon is Lenovo's "thinnest ThinkPad ever built" and although it's not quite 'MacBook Air thin', for a business-oriented notebook this is a fantastic ultraportable with a chassis constructed out of luxurious and tough-feeling carbon fibre and a reasonable weight of 1.31kg, with a nice compact charger that only adds another 200g. This is actually the third iteration of the ThinkPad X1, so Lenovo's had some time to refine the design – and we reckon it's got it just right this time out.

We tested the top-specced model, with a dual-core Intel Core i7-5600U that operates between 2.6-3.2GHz, 8GB of memory and a 256GB SSD. It was, unsurprisingly, a ripper in terms of responsiveness and general usability on the desktop, but it's even capable of a little light gaming thanks to an Intel HD 5500 GPU. You won't quite be playing the latest games at native resolution, but if you keep your expectations modest this chip holds up OK in non-demanding titles.

Perhaps the thing we like most about the X1 Carbon is that it proves that slim doesn't need to mean 'light on features'. Lenovo's packed a good deal of extras in here, with a clean and crisp 14-inch (2,560 x 1,440-pixel) touchscreen display, a comfortably large matte-finish trackpad and well-separated, and ergonomically-shaped keyboard keys that have a satisfying action. There's two USB 3.0 ports (one on either side), both a trackpad and pointing stick (or 'nipple', as we affectionately like to call it here in *APC* Labs), an Ethernet dongle, swipe-based fingerprint reader and even the option of a micro-SIM card slot and built-in 4G radio that supports the major cellular bands (the Sierra EM7345). There's also a nifty fast-charging battery tech, which restores about 80% in an hour. In fact, feature wise, the only notable omission is that there's no SD card slot – so if you're after a photographer's laptop, there are perhaps better choices.

In use, the only feature we really had an issue with was the display. While it's gorgeous to look at, this 14-inch size and 2,560 x 1,440 pixel match up doesn't work particularly well. We've taken other laptops to task for similar problems – and to be fair, the issue is with Windows, which doesn't handle rescaling its interfaces to certain size/resolution settings very well... this regrettably being one of them.

This results in many elements that are either oversized or strangely fuzzy – a problem that's particularly apparent in third-party apps. Thankfully, you can also opt for a standard 1080p panel with the X1 – and save yourself $200 at the same time. Unless you're particularly fond of futzing about with Windows graphics settings, we know which we'd choose.

That issue aside, there's little else to complain about here. We'd perhaps have like an extra USB port or two, and the top-mounted left and right trackpad buttons can take some getting used to (you're better off using multi-touch). This is, then, just about the perfect business portable: robust, sleek and speedy as hell. ■ **Dan Gardiner**

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★

A fantastic business laptop that offers a great mix of speed, style and toughness.

★★★★½

GAMING LAPTOP

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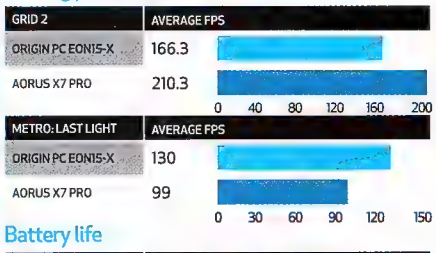
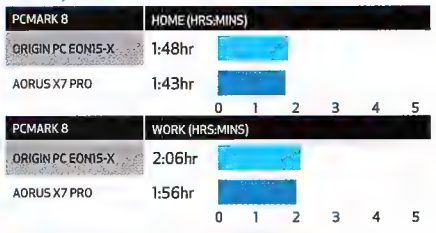
LABS BENCHMARK RESULTS

General system performance

Gaming performance*



Battery life



* ALL GAMES TESTED AT 1080P/MEDIUM DETAILS.

Origin PC EON15-X

Delivers desktop power in a portable package… with some caveats.

Combining a desktop-class 4th-gen Intel Core i7 processor (in our test machine, the i7-4790S) with a GeForce GTX 980M graphics chip, this EON15-X slew just about every other laptop that's come through our labs before it.

We'll get back to that performance in a minute, but first, a quick detour to look at the overall build. While heavy at 3.5kg (plus another 900g for the gigantic charger), there's a lot to like otherwise. The looks are fairly low-key, and the whole chassis has a pleasing, soft-touch, matte black plastic finish. There's a big speaker bar below the screen which sounds quite full and punchy (considering its size), plus you get a heap of ports: four USB 3.0s, an HDMI and two DisplayPort outputs on the back, Gigabit Ethernet, eSATA and even optical audio out.

Inside, the CPU and GPU are accompanied by 16GB of 1,600MHz Kingston DDR3 and an m.2 SSD for storage. The latter's where our review unit felt a little under-specced – at this $3,399 price you only get a 120GB model. Really, if you're spending this type of dosh, it'd make sense to upgrade to the optional 500GB Samsung SSD (which Origin tells us is an 850 EVO) for an extra $330. That bumps the price up to around $3,800, but you end up with a much better balanced machine.

Something else that could be better is the viewing angles on the 15.6-inch 1080p display. They're a little narrower than we'd like, with the tendency for colours to either invert or wash out outside of a roughly 140° arc. The display is otherwise respectable, with nice even colouring and enough contrast that you don't lose too many details in darker games.

As we mentioned earlier, there's no doubting the speed on offer here. The EON15-X's PCMark score of 5,355 is the highest of any portable we've tested – around 700 points ahead of the next best, Aorus' X7 Pro. And it eats up games too, with frame rates well above 60fps in even the most demanding conditions. While the aforementioned Aorus laptop is technically faster, it has two GTX 970M GPUs in SLI. In terms of single-GPU performance, the EON15-X is the fastest you'll find.

With all that high-end hardware, you'd be right to wonder about heat. Intel's desktop and mobile parts are closer than they've ever been, but there's still a big difference. Desktop chips are clocked higher, draw more power and need more cooling, so to handle all that the EON15-X has a huge charger and a mass of cooling hardware to pump hot air out of two (frankly huge) vents located in the laptop's rear.

In terms of temperatures the 980M graphics chip fares well, peaking at a healthy 70°C when gaming at 1080p with all the details pushed to max. The CPU results get a little more iffy, however, reaching 92°C – and the 4790S chip is rated at a maximum of 100°C. That's flying pretty close to the line.

Considering the top-end hardware, the EON15-X's battery life was actually passable – it can manage a bit over 2 hours when doing office tasks.

In sum then, while there are a few slightly contentious areas (some of which can be rectified by opting for different parts at the config stage) this is a super fast and even vaguely portable high-performance laptop. ■ **Dan Gardiner**

Verdict

Features ★★★★½
Performance ★★★★
Value ★★★½

That desktop chip sails close to the thermal limit, but there's no denying this one's top-notch performance.

★★★★

MONITOR

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Dell UltraSharp U3415W

Dell shows how to do curved displays right with its new 34-incher.

When it comes to monitors, bigger is better – space on your desk and your wallet not withstanding. The latest trend for displays is the ultra-wide 21:9 format, for which a range of vendors including Samsung, Dell and LG have produced the impressively-sized 34-inch 3,440 x 1,440 displays. This is, all up, *five million pixels* and roughly 20% larger than two standard 1,920 x 1,080 displays – only with greater pixel fidelity and no annoying bezels getting in the way. Oh, and curved, just to add icing on the liquid-crystal cake.

Of course it doesn't come cheap, at $1,299 give or take how well you bargain. And if you plan to use it for gaming you'll want to make sure you can drive it too – a recent 700-series or 900-series Nvidia card or AMD equivalent will be a must.

But how does it look? Splendid, in a word. We had the pleasure of entertaining the U3415W and Samsung's S34E790C (see next) and having two of these made for quite the sight – though the two performed quite differently.

Dell opted for an AH-IPS panel in the U3415W, the same as in its popular U3014 30-inch monitor, providing great colour reproduction and excellent contrast while handling off-centre viewing angles better which, as you might expect, helps the wide-format and curved display. To drive this, Dell added ports for DisplayPort 1.2 as well as HDMI 2.0, either of which can power 3,440 x 1,440 at 60Hz (and note you'll need to confirm your GPU has HDMI 2.0 or DP before choosing to buy this screen).

Controlled via touch-sensitive buttons on the bottom bezel, the OSD offers plenty of options for tailoring the display including presets like Paper for casual viewing and the classic Movie and Game modes that all monitors seem to have these days. The Dynamic Contrast feature sounds great in principle but we found it too distracting in practice. Better left off. The Uniformity Compensation made an appreciable but subtle difference, though disappointingly it's disabled for all but the Standard and custom colour modes.

As with the Samsung S34E790C, an option for over-driving is included, and while we didn't notice as great an improvement as with Samsung, it also exhibits less artifacts in the process. On the whole, we preferred the standard mode which as it stands, still features an 8ms GTG response time.

Opting for an internal power supply, and with height and tilt adjustments on the stand, you'd be forgiven for thinking the U3415W ticks all the boxes, but if it has one flaw it's that backlight bleeding is readily apparent in all four corners. It's not hugely distracting, but we've seen better.

Is a 21:9 ultra-wide screen for you? The desktop real-estate alone is a boon for productivity, while movies (if in anamorphic cinema format) and games look great too, if you can drive the high pixel count. And the curve? To be fair, unlike curved TVs where it feels more of a gimmick, here it seems to help with the wide aspect ratio. We're suitably impressed.

Ashton Mills

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★

A well-specced AH-IPS display, where the curve isn't just a gimmick. Nicely priced, too.

★★★★½

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- 2 x VPN tunnels with hardware accelerator
- Advanced Wi-Fi for Vigor2760n and Vigor2760Vn
- SIP VoIP (2 x FXS and 1 x Line port) for Vigor2760Vn

Vigor2860 Series

- Built-in VDSL2 / ADSL2+ modem, 1 x Gigabit WAN port & 2 x USB ports for 3G/4G Mobile with Load Balance and Fail-Over
- 6 x Gigabit LAN ports with 50,000 NAT sessions
- 32 x VPN tunnels with VPN load balance and redundancy, Central VPN Management & 16 x SSL VPNs
- Advanced Wi-Fi for Vigor2860n
- Dual-Band Wi-Fi for Vigor2860n-Plus & Vigor2860Vn-Plus
- SIP VoIP (2 x FXS and 1 x Line port) for Vigor2860Vn-Plus

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Vigor2120 Series

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- 4 x Gigabit LAN ports with 30,000 NAT sessions
- 2 x VPN tunnels with hardware accelerator
- Dual-Band Wi-Fi for Vigor2120n-Plus

Vigor2912 Series

- 2 x Fast Ethernet WAN ports & 1 x USB ports for 3G/4G Mobile with Load Balance and Fail-Over
- 4 x Fast Ethernet LAN ports with 30,000 NAT sessions
- 16 x VPN tunnels with hardware accelerator & VPN Fail-Over
- Advanced Wi-Fi for Vigor2912n

Vigor2925 Series

- 2 x Gigabit WAN ports & 2 x USB ports for 3G/4G Mobile with Load Balance and Fail-Over
- 5 x Gigabit Ethernet LAN ports with 50,000 NAT sessions
- 50 x VPN tunnels with Central VPN Management & 25 x SSL VPNs
- Advanced Wi-Fi / Dual-Band Wi-Fi / VoIP

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PC MONITOR

$1,599 | WWW.SAMSUNG.COM/AU

Samsung S34E790C

Curved, but not in the right places.

Sporting the same dimensions as the Dell U3415W, and curved just the same, the S34E790C exhibits classic Samsung styling with a sleek minimalist metallic stand and thin bezels. OSD controls have been moved to the rear through use of a small button joystick. It's clever but not as easy to use as it sounds, with mis-clicks a-plenty while navigating options.

The stylish design would be a lovely complement to a great screen if the screen was, well, great. Straight off, we found the picture quality lacking, though – text was soft, almost blurry, and no amount of OSD tweaking helped. Oddly the only mode that improved it was Game mode, though it was still no match for the Dell. Added to this was a subtle 'crawling' line effect up the screen, presumably an artifact from the on-board processing. Connection wise the S34E790C disappoints: the HDMI connectors are only HDMI 1.4 compared to the Dell's 2.0, limiting an HDMI connection to 50Hz. We used DisplayPort for testing and you'll want to do the same for 60Hz. Mode presets include 'MagicBright' and the aforementioned Game mode, as well as tweakable response time settings. Samsung claims a 4ms GTG at the faster presets, and while these noticeably improved response, they also introduced excessive overdrive artifacts. Despite good contrast and colour reproduction on this SVA panel, we can't help feel that Samsung has fallen short of its usually high standards. Hopefully a firmware update can iron-out some issues, but between this and the Dell, there's really no competition. ■ **Ashton Mills**

Verdict

An underwhelming implementation of curved display tech.

★★½☆☆

PC CASE

$175 | WWW.THERMALTAKE.COM.AU

Thermaltake Core X2

Big is apparently the new small when it comes to case design.

On the face of it, Thermaltake's new Core X2 case is a rather absurd beast. It's been designed to house small motherboards of the micro-ATX and Mini-ITX variety and yet is itself most definitely not small. It's wider than the Cosmos Ultra chassis that's home to one of our review rigs, and almost as tall. Given that we've long been extolling the performance virtues of today's mini motherboards, is its size really an issue? We built the Core X2 up with a powerful X99 mATX motherboard from ASRock and it was a joy to work with. The removable motherboard mounting plate allows you to get board and cooler in place with the absolute minimum of fuss and means you can fit both the PSU and storage drives in first with unprecedented access to both. And both drive cages, situated vertically and horizontally beneath the motherboard, are removable too, as are the 5.25-inch drive bays. This means you can configure the Core X2 with a huge amount of space inside for good airflow. And should you feel the need you could fit three 360mm radiators in this thing. Targeting airflow may be a slight issue though given the entire case is vented, aside from that large Perspex side-panel. That lends the Core X2 an industrial aesthetic, most definitely leaning on the function-over-form side of chassis design. If you're serious about putting together a well-featured, overclocked system, sporting a powerful mATX motherboard, then this latest Thermaltake chassis is going to be a great case to build that into. ■ **Dave James**

Verdict

Versatile; easy to build; accessible; great cooling options. But a little pricey and uninspired looks.

★★★★☆

SOLID-STATE DRIVE

$549 | WWW.CRUCIAL.COM

Crucial BX100 1TB

The flagship of Crucial's new budget-oriented BX100 range.

The last time Crucial launched an SSD, the extremely popular MX100 series, it pretty much decimated the market in terms of pricing. And now it's back to pick over the bones with a drive very much aimed at the budget buyers, the BX100.

This 1TB drive is joined by 120GB, 250GB and 500GB capacities, all with quoted 535MB/s sequential read speeds. Sequential write speeds are a different matter. The 500GB and 1TB models are both rated at 450GB/s, while the 250GB drive manages 370GB/s and the 120GB drive scrapes in with a lowly 185GB/s.

Perhaps the most surprising thing about the BX100 series is the choice of controller. Gone is the usual Crucial first choice of a Marvell chip. In its place is a four-channel Silicon Motion SM2246EN. It's the first time this controller has seen the light of day in a Crucial drive. Alongside the controller in the 1TB drive are 16 16nm Micron 128Gb NAND packages (eight per side) together with 512MB of DDR3 cache (in two 256MB chips).

As befitting its budget status, the BX100 range doesn't come with any hardware-based encryption, or indeed any of the other fancy bits and bobs that previous drives had. And, although it can monitor its internal temperatures, it doesn't have the thermal throttling technologies of previous drives either.

So how does that Silicon Motion controller do against the more familiar Marvel chip in the M550 1TB drive or Samsung's own controller in the similarly-priced 1TB 850 EVO? Unfortunately we can't compare it directly against the MX100 as Crucial never produced a mega capacity MX100, limiting it to 512GB max.

It has be said it holds up pretty well. In the ATTO benchmark it keeps pace with the 850 EVO and the M550 when it comes to sequential reads, but its Achilles' heel shows up in the ATTO sequential write test. Here it lags behind both the Samsung and the M550. It's the same story in the sequential write test of the AS SSD benchmark with the BX100 lagging behind the other two.

However, when it comes to the AS SSD 4K (the small bitty files of everyday use) write test, the roles are reversed with the BX100 coming out the clear winner. Doing some real life testing, timing how long it takes to copy a 60GB Steam folder (29,521 files), the two Crucial drives are fairly close together, but both are left behind by Samsung's drive. Crucial may claim it's not the fastest drive around, but for the market it's aimed at, its overall performance isn't to be scoffed at. The same can be said for its performance in PCM08's Consistency test. Its overall best score of 4,913 is pretty good for a drive aimed at the lower end of the market.

The BX100 has decent endurance for a drive aimed at the budget end of the market too, being rated at 72TB of drive writes with a 3-year warranty. The main problem for Crucial is that Samsung's 1TB 850 EVO is the same price as this BX100 in Australia. It needs to be a lot cheaper to compete.

Simon Crisp

Verdict

Features	★★★½
Performance	★★★★½
Value	★★½

Decent performance, but lacking features and too highly priced.

★★★

SOLID-STATE DRIVE

$319 | WWW.CRUCIAL.COM

Crucial MX200 500GB

All set to take over from the MX100 and M550.

Rolled out at the same time as the budget-minded BX100, the MX200 is Crucial's latest drive for the mainstream market, but can be seen as a replacement for both the MX100 and M550 drives.

There's no 120GB version of the MX200, so this 500GB unit sits between the entry level 250GB drive and the flagship 1TB monster. The two smallest capacity drives are also available in the mSATA format and two M.2 versions – 2260 and 2280. Crucial quotes sequential read/write figures for the whole MX200 family, including mSATA and M.2, of up to 555MB/s and 500MB/s respectively. The 250GB 2.5-inch drive, and all the M.2 and mSATA drives, get a performance boost from Crucial's Dynamic Write Acceleration (DWA) technology. In a nutshell, DWA takes a portion of the MLC NAND and treats it like SLC NAND to cache write IOs, which are then written to the MLC NAND during the quieter periods of drive use.

The new drive uses the same Marvell 88SS9189 controller as the MX100, and the same 16nm Micron NAND for that matter, but as this is the second generation of drives with this combination, Crucial has really got to grips with the firmware and with improvements in the write technologies. This has given the MX200 some serious endurance figures. Endurance for the 500GB drive is rated at 160TB TBW (total bytes written), which works out at 87GB a day for five years. That's a huge increase over the 72TB TBW of the 512GB MX100, though the MX200 only comes with a 3-year warranty and has a MTTF of 1.5 million hours.

Performance-wise, the MX200 is pretty much in the same ballpark as its MX100 predecessor when it comes to sequential read/write performance. The MX200 scores 539MB/s and 510MB/s in the ATTO benchmark compared to the 535MB/s and 512MB/s read/write of the MX100. In the AS SSD sequential test the MX100 outperforms the MX200, particularly when it comes to reads with the review drive scoring 468MB/s as compared to the MX100's 508MB/s.

However, when it comes to dealing with the small bitty files of everyday use, the two drives perform pretty much the same when it comes to read performance. This is ably shown by the 4K read test in the AS SSD benchmark. The MX200 produces a result of 25.06MB/s compared to the 24.81MB/s of the MX100. But Crucial's tinkering with the write technologies in the firmware to increase endurance has had the additional benefit of giving a real boost to the MX200's write performance. The 4K write test in AS SSD has the drive scoring 90.27MB/s compared to the 56.40MB/s of the MX100. The new drive also shaves very nearly four minutes off the time it takes to copy a 60GB Steam folder.

The MX200 certainly has hard acts to follow in the M550 and MX100, but, Crucial does have a real winner on its hands, particularly with the massive increase in its endurance over the previous generation(s) of drives.

Simon Crisp

Verdict

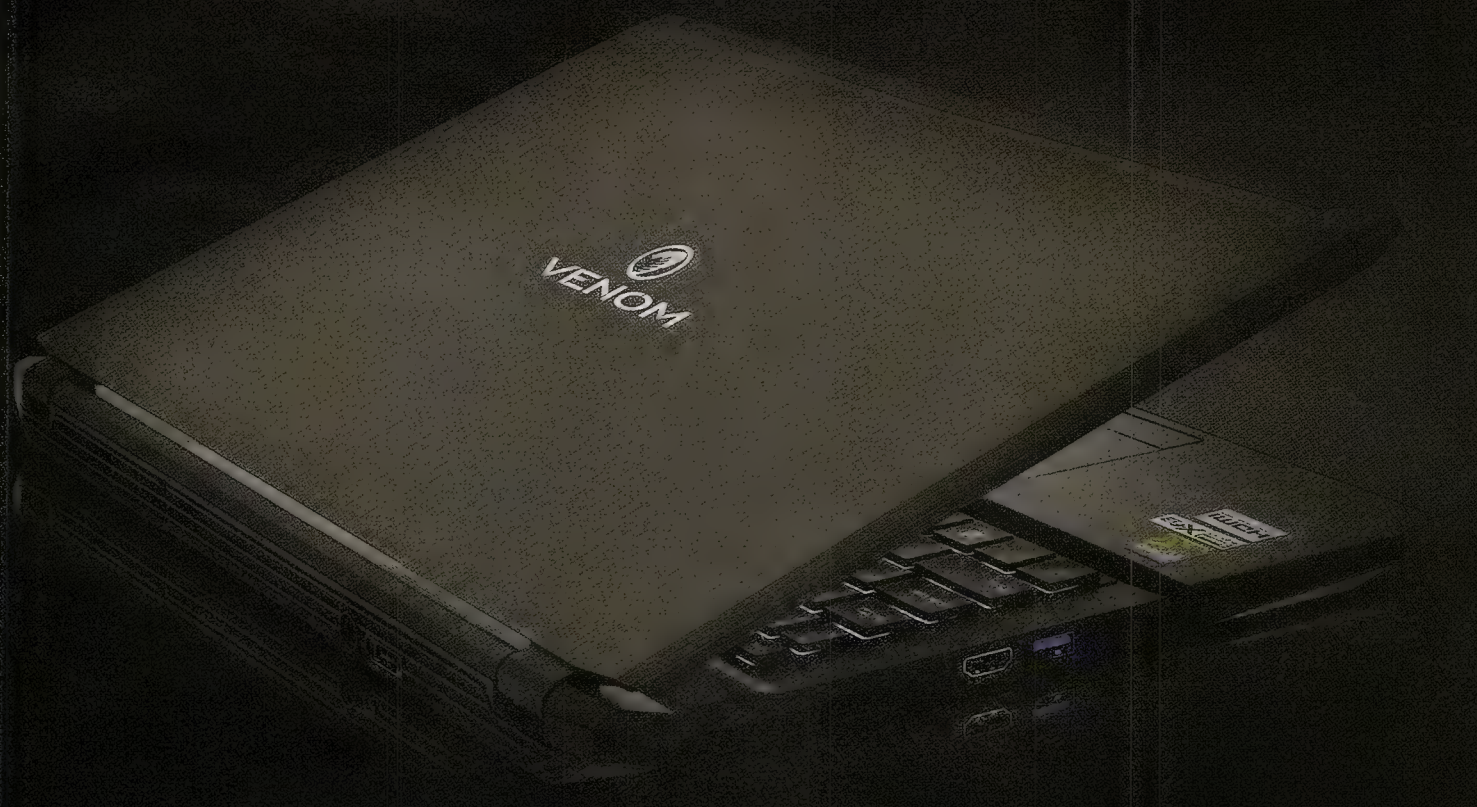
Features	★★★★
Performance	★★★★
Value	★★★★

Impressive 4K write performance; decent price; incredible endurance.

★★★★☆

VENOM

BlackBook 15



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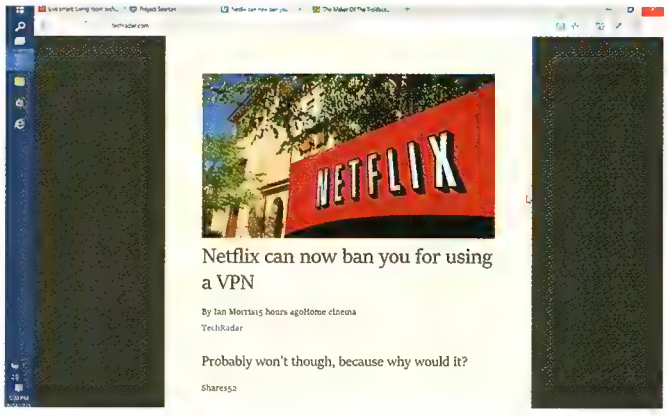
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By Ian Morris15 hours agoHome cinema
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Microsoft Project Spartan

This is (Project) Sparta(n)...?

FREE | MEETPROJECTSPARTAN.COM

Available only in the Windows 10 Technical Preview (which you can download for free from *windows.microsoft.com/en-au/windows/preview-iso*) Project Spartan is the working name for Microsoft's next web browser, which is being designed to eventually replace Internet Explorer. It's currently in a preview state and, like the rest of Windows 10, its designed to be minimalist and lean, with a fairly 'flat' interface design that's meant to work equally well on traditional PCs or via touchscreens on tablets. We spent some time with the preview build and, while it's showing early promise, it's too light on features at present for us to deliver any sort of verdict.

What we can say is that the new rendering engine makes browsing in general exceptionally fast (seriously — just blink and a whole page is loaded) with no real performance hiccups and very smooth scrolling, even on demanding image-heavy pages. The control elements and icons are large enough to be tapped easily, but not so big that they feel comically oversized when you're using a mouse and keyboard.

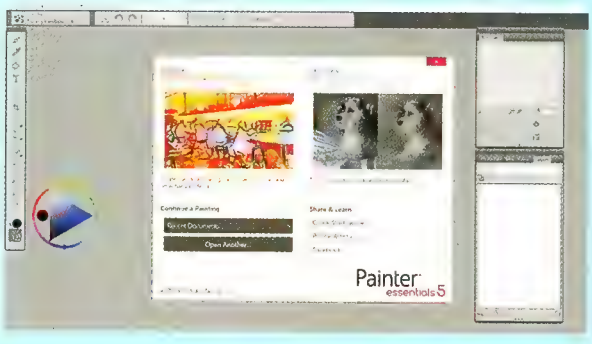
There are a few advanced features, like a built in Reading List and Reading View (which <cough> Safari has had a version of for a while now) which lets you save web pages and/or view them in a stripped-down 'text and images only' format, much like the Readability or Pocket services. You can also make notes on web pages (including scribbling over screenshots if you're using a tablet with a stylus) which can be saved to your OneDrive cloud storage and opened in OneNote. Microsoft's also claiming Spartan will be more secure than IE.

Spartan is still a little rough in parts: some pages didn't render properly, placing side panels above the main body copy on some web sites — so for us, this won't be replacing Chrome any time soon. **Dan Gardiner**

Corel Painter Essentials

$59.95 | PAINTERARTIST.COM/AU

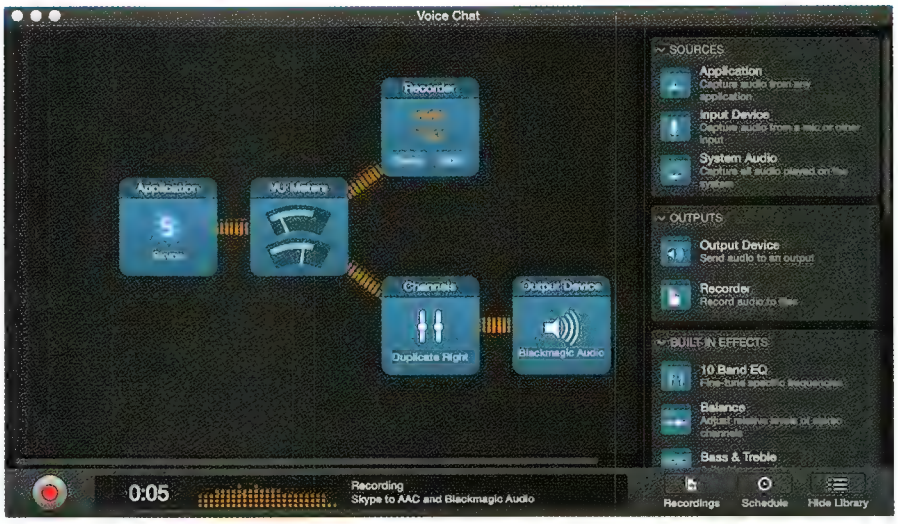
We were impressed by the natural-media painting tools in the recently-released Painter 2015, but at over $500, it's far too expensive for most people. Painter Essentials 5 is not only cheaper — just $60 — but has a simpler, more streamlined interface that is much easier for newcomers to work with. The welcome screen in Painter Essentials 5 offers two different modes for creating your artwork. Beginners can start with the automatic Photo Art mode, which allows you to import a photo and then sit back while the program paints over it using a variety of different brush styles, such as watercolours, oil paints, or pencils. More experienced users can create their own artwork in Drawing And Painting mode. This provides dozens of different brush and pencil styles, including a new Mirror mode that reflects brush strokes like a mirror image. There are also some powerful new 'particle' brushes that can create finely detailed strokes for painting hair or delicate materials such as silk. Not surprisingly, Painter Essentials has fewer features than its big brother — only 106 different brushes, compared to 800 for Painter 2015. Even so, that gives amateur artists plenty of scope to experiment, while features such as the Photo Art mode mean that you don't need to be a skilled artist to get started. At just $60, this is a powerful and fun graphics tool for amateur artists. **Cliff Joseph**



Audio Hijack 3

A true recording star for your Mac.

$49 ($25 UPGRADE) | ROGUEAMOEBA.COM



Audio Hijack 3 has been completely rebuilt from the ground up to make it stupidly easy to record every sound your Mac system makes, or only those from specific applications and devices. This core functionality existed in previous versions, but often with some degree of mystery as to what the final recording would sound like after fiddling with various menus and settings.

That's no longer the case: gone are those archaic controls, replaced by templates used to set up recording sessions for common scenarios, such as voice chats, podcasting, digitising old vinyl LPs piled up in the closet, or simply ramping up the volume on Macs with tiny speakers. (There's also the option to start completely from scratch.)

Most of the 10 included templates work without modification, but can be further customised using icons from a sidebar on the right-hand side of the session window. Once placed on the audio grid, these so-called 'blocks' control the flow of audio through the application. The library is made up of Sources (what do you want to record?), Outputs (where should the sound end up?), Meters (for in-line visual feedback), and Built-In or Audio Unit Effects that offer aural enhancements such as EQ, denoise, or the very useful option to 'duck' one audio signal under another.

Each block can save presets with favourite settings, and sessions can be endlessly customised and reused at a later date. Once configured, a click on the record button starts or stops the process, with orange meters providing reassuring confirmation that the audio is actually being recorded as it moves through the active links between blocks – the digital equivalent of checking the tape is moving.

About the only thing missing is a one-click shortcut to edit audio files in other applications such as Fission; instead, you have to click a magnifying glass icon under Recordings to reveal the file in the Finder, then open it manually. Fortunately it's a minor inconvenience in an otherwise outstanding audio recording powerhouse.

So, while it's easy enough for novices and powerful enough for pros, Audio Hijack 3 takes the anxiety out of recording sound from your Mac, making it drag-and-drop simple in the process.

J. R. Bookwalter

Dart

SEND LOVE LETTERS STRAIGHT FROM YOUR DART.

$1.99 | DART.EMAIL

Dart cuts emails down to size. From the Mac menu bar, you can compose short messages with a series of predefined answers, sent from the email account of your choice. All that's required from the recipient is to select an answer and hit send.

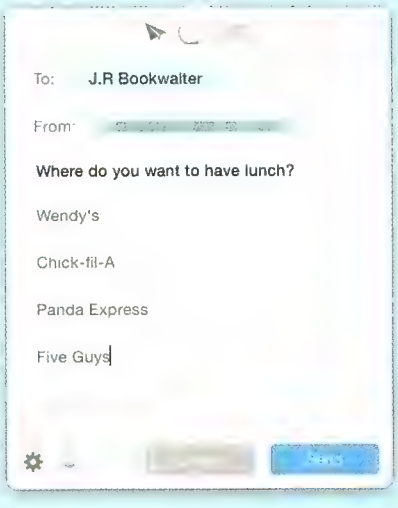
There's also a traditional mode with subject field and 200-character message for more involved missives. Messages can include emoji but not image attachments, and you'll need an email client for reading replies – Dart is strictly about sending messages.

There's zero setup, since the app takes advantage of accounts already on your Mac (and others can be added), although you'll need to re-enter passwords before sending for the first time. iCloud, Gmail, and Outlook accounts with two-factor authentication all work, but require the generation of app-specific passwords.

On the downside, sending from iCloud accounts is limited to the default alias in Mail preferences, and a preference setting to start at login refused to stay selected.

Dart is convenient for sending bite-sized email text messages from a Mac, but it won't replace your existing email or messaging clients.

J. R. Bookwalter



Alfred Remote

Computer functions controllable from your smartphone.

$6.49 | WWW.ALFREDAPP.COM/REMOTE

Alfred 2 for Mac is a powerful search tool that allows you to quickly find files on your computer, perform time-saving online searches, and create your own workflows. Now, you can connect to Alfred 2 with the new Alfred Remote for iOS.

Alfred remote feels very slick, with a gorgeous design, and controls that feel quick and responsive. There's a sense of quality over the product that alludes many other remote apps.

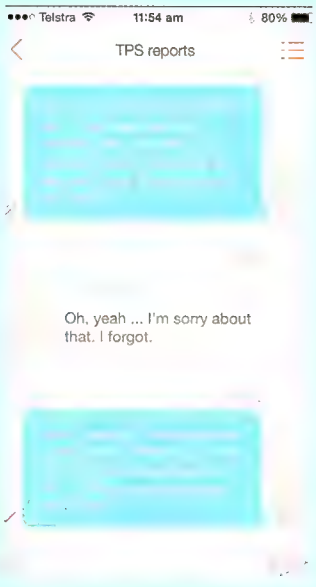
That said, the Alfred Remote is surprisingly limited in its functionality. You can control iTunes, put your computer to sleep, logout, shutdown and restart, but Alfred Remote's other workflow configuration options prove somewhat useless unless you're sitting in front of your computer. If that's the case, why bother using the remote at all?

Spend some time configuring Alfred Remote on your Mac, and you'll be able to perform very simple tasks that aren't worth the effort. Excusable if it were free, but at $6.49 the Alfred Remote is hard to recommend.

Stephen Lambrechts

Mailburn

FREE | WWW.MAILBURN.COM



If the thought of composing emails from your phone is enough to get you all riled up, perhaps the new messaging app Mailburn is what you've been waiting for. Created by Daniil Pavlyuchkov, Mailburn makes sending emails as simple as sending text messages.

Mailburn lets you attach images just like in an MMS, and also access your Google Drive for easy document attaching. It's cleanly designed, with a look that's similar to your iPhone's Messages app.

Admittedly, the app works better with smaller, less cluttered messages. Long email signatures get included in your messages, making them look like they go on forever. It looks even worse when the email has been forwarded a few times and features a string of links.

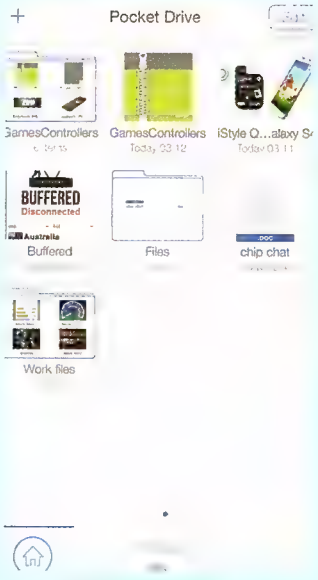
Still, browsing conversations is great, and you can also access attachments without opening a message.

Unfortunately, we also experienced long delays in the delivery and arrival of our emails at times. Mailburn is a neat concept, but it could do with some more tweaking.

Stephen Lambrechts

Pocket Drive

FREE | WWW.POCKETDRIVEAPP.COM



Ever needed to take a stack of files with you, but didn't have a USB stick on hand? Thanks to the new iOS app Pocket Drive, you can now have a wireless one in your pocket at all times. Pocket Drive lets you wirelessly connect to a PC or Mac with almost no effort at all, letting you transfer files between your computer and your iPhone in a matter of seconds.

It also couldn't be easier to use. While most wireless USB drive solutions involve going through various settings, Pocket Drive simply requires you to be on the same wireless network as your desired computer. Just open a window and accept the mounting request (easy tiger, at least buy me a drink first).

You can also use Pocket Drive to open files within the app, including PDFs, MP3s, MP4s, ZIP files, HTML files, and more. You get 512MB of storage for free, or you can access all the space on your phone for $6.49.

Stephen Lambrechts

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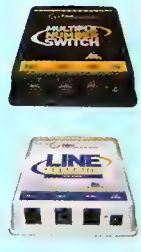

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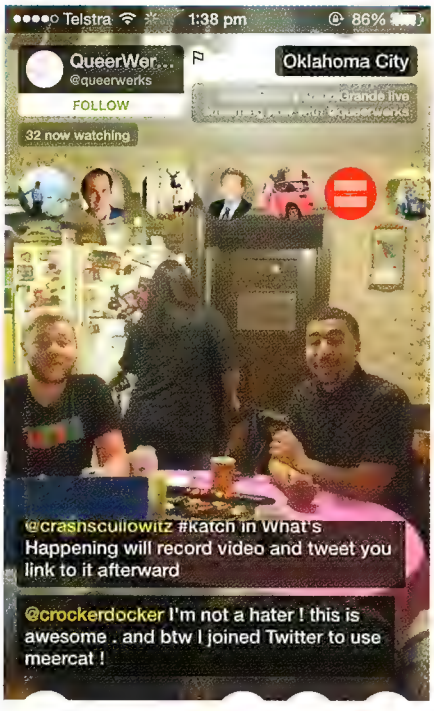
Google Play » ANDROID

Meerkat

Streaming video + Twitter = surprisingly compelling.

FREE | TINYURL.COM/APC415-MEERK

Evoking a mental image of the comical mongeese that poke their furry heads above the grass to see what's going on, those behind the Meerkat app couldn't have picked a better name for the live-streaming service. Launching alongside a similar (and now official) app named Periscope, Meerkat plugs into your Twitter account and allows you to post live video streams using your mobile. Though originally an iOS exclusive, some of the devs have created an unofficial client for Android phones. Considering how useful applications like Twitch are for gaming fans, we suspect Meerkat will be able to run with the concept of live-streaming and expand it into other areas that lend themselves to live video. Because it is still a new app, finding a live stream is currently a little tricky, though there is a leaderboard that will show you the most-popular streams and you can search Twitter for #meerkat to find live feeds. The success of this app will depend on its proliferation and once a few of the companies or media outlets that you follow start using it, it could very well become an awesome resource. Joel Burgess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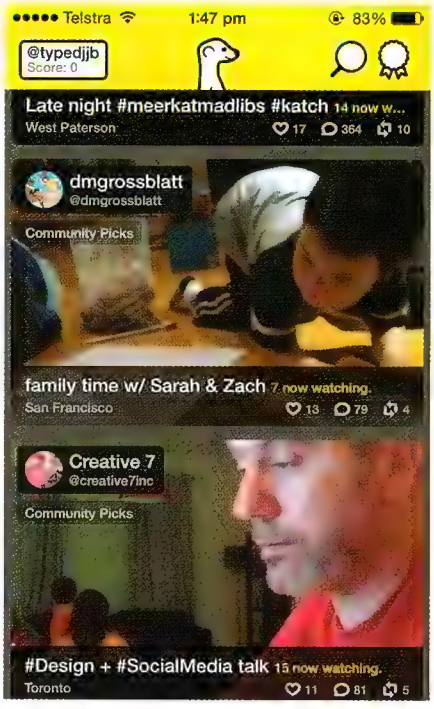
32 now watching
@crashsculowitz #katch in What's Happening will record video and tweet you link to it afterward
@crockerdocker I'm not a hater ! this is awesome . and btw I joined Twitter to use meercat !



Instant

FREE | TINYURL.COM/KA2V3PR

If you're the kind of person who constantly pulls your phone out of your pocket, for seemingly no reason other than for something to do, you'll appreciate Instant. It's a new Android app that keeps tabs on your smartphone habits, acting as somewhat of a rude awakening to those who don't know they have a problem. Instant by Emberify runs in the background of your phone, counting the minutes you spend looking at it, viewing apps, and even counts the physical steps and minutes you've spent being active throughout the day when linked to the Google Fit app. It can also tell you have many times you've unlocked throughout the day, leading you to the realisation of how ridiculous it is to unlock your phone eight times in the space of a couple of minutes. The app will also create detailed graphs and show you statistics about your phone usage, though that'll cost you (it's around $1.30 a year for an Instant subscription). Stephen Lambrechts

Pixel OFF

FREE WITH IAP | TINYURL.COM/APC415-PIXEL

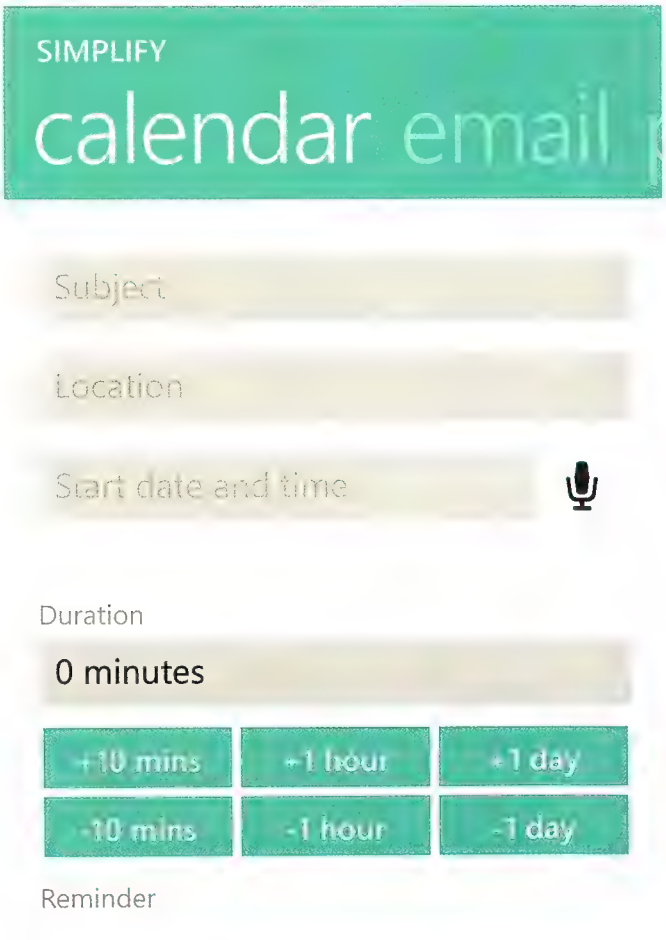
Pixel OFF takes a unique approach to saving smartphone battery life: it turns off screen pixels. That's a good idea in theory: the majority of battery drain comes from the screen. The one catch is that it only works with AMOLED devices, like Samsung's Galaxy family and Motorola's higher-end Motos. If you've got an LCD display, you're out of luck, as LCD pixels can't be individually turned off. The app itself if pretty simple: it's free to use the basic 'low' power saving mode, which seems to switch off about half the pixels (more aggressive modes can be unlocked by paying $1.99) and you can choose whether the app is automatically loaded and only turns on at a certain battery percentage. And it does seem to work, to a degree — playing a video for an hour with and without Pixel OFF activated drained 10% and 12% battery, respectively. In general use (web surfing, email, casual gaming) we didn't notice any difference in on-screen detail either. The main problem is that turning off pixels reduces brightness, so turning it up will undo the power-savings. And turning down the brightness would likely give you the same end result — no app needed. Dan Gardiner

Simplify

Simple reminders you won't forget.

FREE | TINYURL.COM/APC415-SIMPL

Yes, it's true, the Windows Phone platform doesn't have the most comprehensive list of apps, nor is the app list within 8.1 the most convenient method of navigating numerous applications, but we have to say; the tiles on the home screen are more versatile and arguably more engaging than the majority of iOS and Android counterparts. This versatility really shines through in apps like Simplify, which allows you to create reminders for events, emails, calls and messages and then pin them to your homescreen. The stock Outlook calendar basically does this if you only have, say, one event per day, but Simplify is more useful if you want to send a message or email at a later point. Simplify will let you pin a pre-written email to your home page and then send it off when you need to by pushing a tile on your homescreen. The app is however a little clunky in use, occasionally crashing to the homescreen and not letting you set timed reminders for emails or messages, but it gets the job done and will be useful for particular types of users. With a few tweaks Simplify will be a solid Windows Phone offering. JB



Onyu

FREE | ONYU.COM

Keeping track of contacts is something we have grown to expect from our phones. But if you're one to be meticulous with an up-to-date contact list, you may want more than a stock contacts manager. While the biggest contact apps tend to be built off the back of an email service (for instance; Google, Apple or Outlook mail/contacts), Onyu takes a different approach, building a messaging service directly into its contacts app. Importing phone and social media contacts is a painless procedure in Onyu and the app's contents are fully encrypted by a user-created password — comforting considering the app lets you store your passport details, licence number and signature. Basically, you fill out personal details and place each under the headings; family, friends, work, private and public — allowing different types of contacts access to different types of personal info. This well-executed app brings a new approach to an old problem and has the potential to be really useful. JB

Tinkerplay

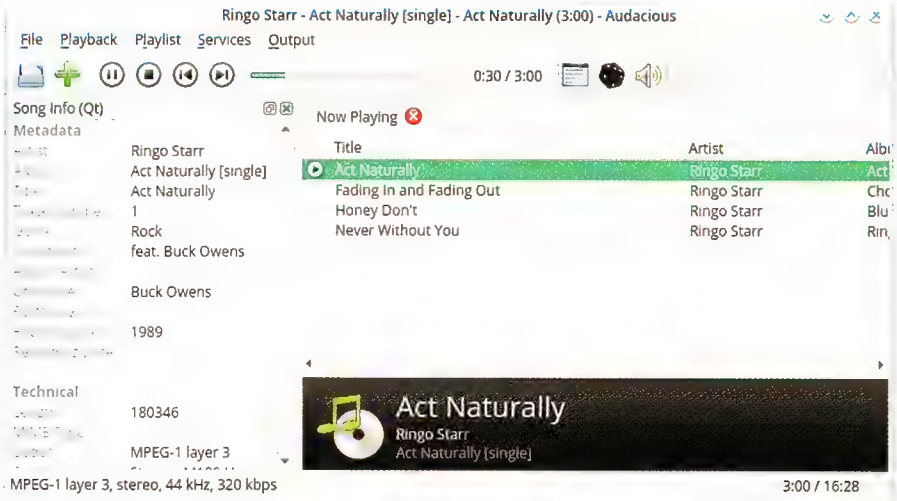
FREE | TINYURL.COM/APC415-TINK

3D printing is a pretty remarkable tech space, fundamentally stretching the conceptual boundaries of industrial design. NASA has sent digital designs of wrenches to the International Space Station and complex designs for musical instruments are readily available on the web, ready to be made by anyone with a 3D printer. If have one of the many consumer (or industrial) 3D printers, then Tinkerplay may interest you. From the publishers of the app Instructables — an info hub of how-tos and DIYs — Tinkerplay is a multi-platform app that will let you design a mini robot-like figurine on your phone. This simple 3D modelling app allows you to piece together, texturise and colour the independent pieces and movable limbs of a tabletop figurine. When you're finished, the app will give you a web link to download the files for your 3D printer. The app is well designed, easy to use and free, so if 3D printing is your thing then Tinkerplay is your app. JB

Audacious

Play that funky music.

FREE | AUDACIOUS-MEDIA-PLAYER.ORG

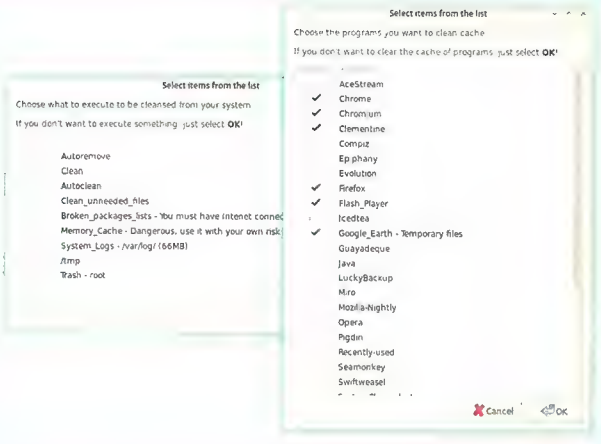


Sometimes it's not easy to distinguish between media players, but in case of Audacious it's not a problem. It's a fork of Beep Media Player (BMP), which, in turn, is a continuation of the classic XMMS. In 2012, Audacious migrated from GTK2 to GTK3, but its developers decided to move back to GTK2 – a rare and unusual move. Among the reasons was a strong dislike of client-side window decorations, Android-style popup messages and dialogs in GTK3, which, the team felt, made it impossible to maintain the classic desktop interface of Audacious. The code was also transferred and rewritten from C to C++, so that it became port.

Recent Audacious releases have added a modern alternative to the legacy Winamp/XMMS interface. The default GTK2/Qt5 application window features playback controls on the top while the media library sits in the middle and track details are at the bottom. There's an additional panel for some plugins, such as searching tracks or song info which appears on the left side, while playlists can be organised as tabs of the main library area. Version 3.6 brought a number of remarkable new features: such as auto-adjusting Winamp skins for HiDPI displays; new track-sorting techniques; correct handling of CUE files with descriptions in separate text files and a new plugin for auto-eliminating silence before and after the song in a track; rewritten output plugins for JACK and sndio etc. Getting Audacious in Ubuntu is easy thanks to Alin Andrei's PPA (ppa:nilarimogard/webupd8), but the latest Audacious version can be missing in other distros, so you can compile it yourself. The build process is straightforward even though the application consists of two parts: the player and its plugins. Pay attention to optional components and switches, that are available via the ./configure --help command. When you have it, you can switch between interfaces in settings, or launch Audacious with Qt5 UI from the very start.

SystemClean

FREE | TINYURL.COM/PLLG6LW



The SystemClean project was started back in 2010 as a script for the Nautilus file manager and after years of polishing, translating and bug-fixing it's become a standalone application of its own. SystemClean does essentially the same job as Bleachbit or Sweeper: it deletes unnecessary and redundant files, configurations, temporary objects and so on. But unlike its high-grade rivals, SystemClean is compact, doesn't have any binary parts and has very few dependencies. At first glance we expected it to work exclusively with Debian, Ubuntu and its derivatives, because SystemClean checks for dpkg and Aptitude. But we discovered that the script actually runs fine on any Linux distro, provided that it already has Zenity, OpenJDK or Java Runtime and Aptitude. On the other Linux systems the script won't remove redundant kernels, but the rest of the features work just fine. Getting SystemClean to run is pretty straightforward. Download the tarball from Gnome Files, extract it and run ./setup. The wizard will only ask you to select the UI language and then copy the main script to the ~./systemclean directory. Browse to that location and run the script. There are two dialogs where you can select which applications and settings you want to clean. The first one offers a choice of several auto-removal variants as well as temporary files, memory cache, trash folders and older kernels. Once you proceed, the main application list will be shown. You need to check the desired applications and click OK to start the process. When the script finishes, it displays output detailing the effectiveness of the work and, hopefully, a lot of free space on your hard drive. The script is actively maintained and according to users' feedback it's safe to use. One of the lovelier features of SystemClean is the generous size of its translation pack, which currently supports 13 languages.

TECH EXPERTS' TOP SECRETS

MASTER YOUR PC & GADGETS! ESSENTIAL TECH KNOW-HOW FOR:

PC UPGRADES, TROUBLESHOOTING & MAINTENANCE ■ WINDOWS ■ MAC ■ LINUX ■ ANDROID ■ iOS ■ BATTERY LIFE ■ NETWORKING ■ STREAMING & DOWNLOADS ■ SECURITY & PRIVACY

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Darren Yates shares his

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Maintenance is important

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44 MAC SECRETS
There's plenty of tweaks to

46 LINUX SECRETS
Ashton Mills offers up

48 ANDROID SECRETS

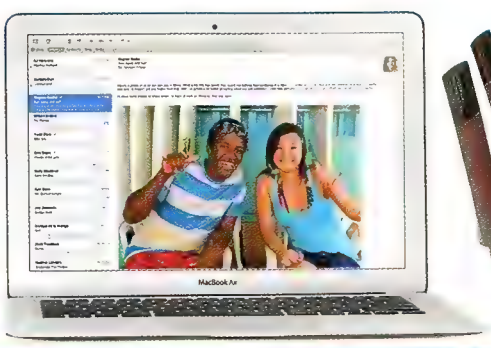
50 iOS SECRETS
Here's our list of favourite

52 BATTERY SECRETS
Use these tips to make

54 HOME NETWORKING SECRETS

56 DOWNLOAD SECRETS
Stay safe while

58 SECURITY SECRETS
Security suites



PC hardware troubleshooting secrets

PC problems don't have to be expensive. Darren Yates shows how to find solutions for a range of common hardware issues.

NEW CPU, OLD BIOS, NO POST

You buy a new CPU and motherboard only to find the board won't recognise the CPU, but how do you update the board BIOS to recognise the CPU without a recognised CPU? This is an occasional issue noted with Haswell-refresh CPUs such as the Pentium G3258 and unless the board already has the latest BIOS, there's often no way to update the BIOS without an original-version CPU on hand. If the board won't POST (power-on self-test), take it back to the retailer, get them to swap the board or do the BIOS update at least, otherwise, buy yourself the cheapest first-gen CPU you can find and do it yourself.

SAVE YOUR PSU FROM 'FEATURE-CREEP'

Feature-creep is a potential problem for power supply units (PSUs) – you add new components to your PC, but keep loading up the original PSU. If you add in a new graphics card (or two), make sure your PSU has the reserves to keep up. If not, the PSU voltage rails will droop, causing random reboots, or worse, pop and possibly damage your components. A good PSU will last you for ages, but don't abuse it by asking it to deliver more power than it's capable of. Both AMD and Nvidia provide guides on minimum recommended PSU wattage ratings for their respective GPUs.

KEEP A KITBAG OF SPARES

This sounds a bit over the top, but if you want to be self-sufficient and ready for any eventuality, keep a kitbag of spares – just low-cost spares you can use to identify 'link in the chain' faults. A US$3 USB-to-Ethernet adapter and a US$1 USB sound card from eBay are perfect for 'A-B' comparison testing for integrated motherboard functions, for example. Also, have your Windows OS installer ready on a USB flash drive in case the systems fails to boot – you can use the recovery menu to possibly repair the system. I also keep a spare PSU and enough parts to build a new system, but that's just me.

POOR OVERCLOCK STABILITY

Overclocking is a dark art that has no rulebook. Just because one CPU reaches a magic GHz number is no guarantee yours will. You really need to thrash the daylights out of your overclock settings before declaring it stable. Use IntelBurnTest/Linpack (**tinyurl.com/kj57e6j**) to find the maximum core temperature (beyond 80°C isn't good for the CPU long-term) and fire up Prime95 (**tinyurl.com/mh59hq6**) for more-accurate long-term stability. The combination of the two should give you a good idea of how your overclock will perform. If the tests fail, drop your settings back a notch and try again. You may also need to improve your cooling system.

IS MY HARD DRIVE DYING?

Self-monitoring analysis and reporting technology (SMART) has been built into new hard drives for ages, but it's not commonly used. After enabling it in the BIOS, grab hold of Passmark DiskCheckup (**tinyurl.com/p35mh86**).

Make sure your PSU wattage keeps up with your PC's expanded features.

Free for personal use, it provides more information than most HDD maker tools and is easier to read. No tool will predict catastrophic mechanical failures, so use SMART for 'slow-burn' wear-type monitoring. Hopefully, HDD failures won't creep up on you and bite you hard – just don't use SMART software in place of a good backup regime. If your HDD is starting to make 'new' noises, ensure you have good backups in place.

WATCH YOUR USB PORTS

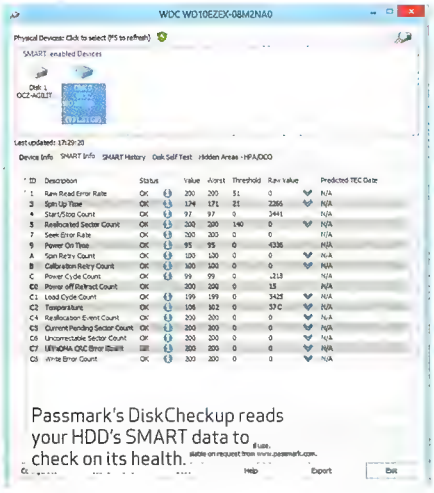
I'm always worried about stuff dragging excessive power out of PC's USB ports, so I use a low-cost USB power meter that measures the current draw directly from the port. They're under US$3 on eBay and typically accurate to 1%. Any device grabbing more than one-amp of current gets booted to a USB AC adapter, for mine.

RAM UPGRADE WON'T BOOT

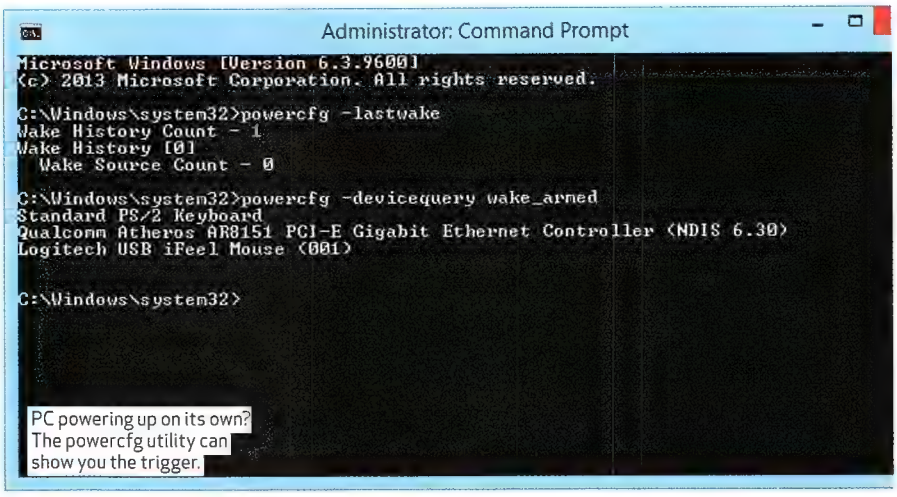
You've installed new RAM but get no POST (power-on self-test)? Make sure the RAM is correctly seated in the DIMM

Keep one of these USB-to-Ethernet adapters in the drawer for troubleshooting.

This HDMI-to-VGA converter gives your LCD monitor an extra HDMI port.



Passmark's DiskCheckup reads your HDD's SMART data to check on its health.


Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.
C:\Windows\system32>powercfg -lastwake
Wake History Count - 1
Wake History [0]
Wake Source Count - 0
C:\Windows\system32>powercfg -devicequery wake_armed
Standard PS/2 Keyboard
Qualcomm Atheros AR8151 PCI-E Gigabit Ethernet Controller (NDIS 6.30)
Logitech USB iFeel Mouse (001)
C:\Windows\system32>

PC powering up on its own? The powercfg utility can show you the trigger.

slot and if using multiple modules, try them one at a time in turn to find the problem stick. Check your DIMM voltage settings are correct in the BIOS (even try reverting to default settings).

PORTABLE HARD DRIVE TICKS

If your portable hard drive won't start and makes 'tick' noises, it's not necessarily a sign it's dead. It could just mean it's not getting sufficient power. If connecting to a USB 2.0 port, use a USB 2.0 splitter to double up on power. If there are no other problems, this should get the drive up and running.

PC TURNS ON BY ITSELF

This seems to affect some Windows 8.1 systems. If the PC boots up of its own accord, use the Powercfg utility to see what woke it by typing at a command prompt:

```
Powercfg -lastwake
```

To see what devices are set to trigger a wake-up, type:

```
Powercfg -devicequery wake_armed
```

You may need to adjust the BIOS settings to turn these off.

MONITOR NEEDS MORE HDMI PORTS

It's rare to find an LCD monitor with two HDMI ports (some don't even have one!). But if you have a VGA port spare, grab a budget HDMI-to-VGA adapter – it'll convert HDMI signals to VGA format and display them on your screen. Avoid cable-only options, make sure it has the converter chip box.

FAILED USB PORTS

On notebooks, failed ports are bad news, but a USB hub will augment any remaining ports. On a PC, front-panel ports tend to be weaker in providing power for devices than the rear ones. If a breakage leaves you short of ports, most boards have unused internal ports. Grab a USB rear-panel bracket from eBay for US$4 to add more.

SSD SLOW-DOWN

If your solid-state drive isn't as fast as it used to be, check you haven't overfilled it. SSDs need empty storage blocks to maximise write speeds and it's generally thought you shouldn't exceed 75% of its capacity to maintain something approaching its original speed (personally, I limit mine to 50%).

BUZZ ON INTEGRATED AUDIO

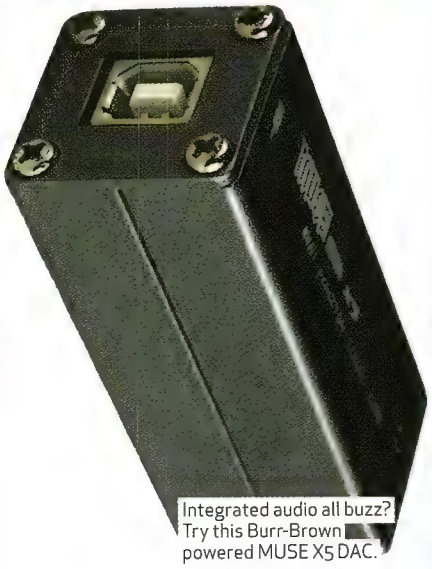
If your PCs' integrated audio delivers a buzz-like sound in the background, it could be poor voltage regulation from the PSU or poor audio design on the board. The solution is often to use USB audio devices instead. Grab a US$1 USB DAC from eBay or spend US$10 on a MUSE X5 DAC with high-quality Burr-Brown PCM2704 DAC.

RECOVER DELETED DATA FROM AN SSD

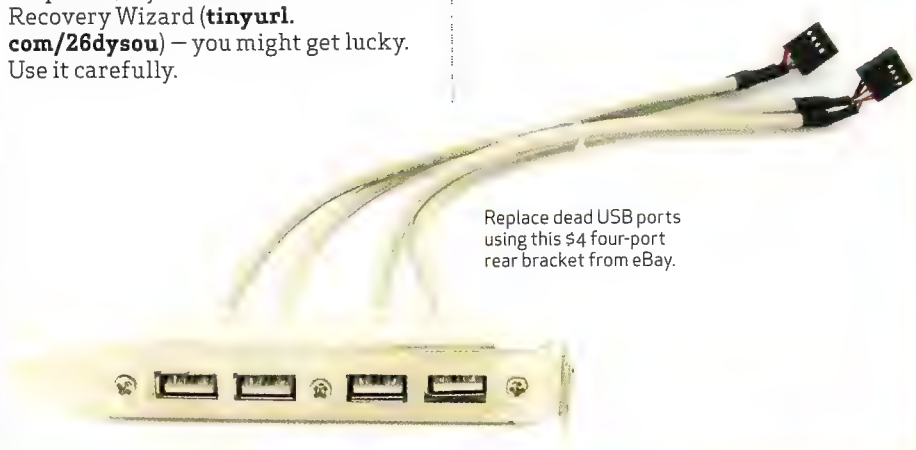
If the SSD is running internally in your system, there's usually little chance of recovering data you've deleted. Modern SSDs use a technique called TRIM to reclaim abandoned (deleted) data blocks and that reclamation is often almost instant. Still, if you're desperate, try the free EaseUS Data Recovery Wizard (**tinyurl.com/26dysou**) – you might get lucy. Use it carefully.

ISOLATING PROBLEM COMPONENTS

The trick to troubleshooting hardware problems in general is isolating the problem component – that means you change one thing at a time and retest, for example, testing RAM sticks one at a time. Any 'before-after' differences can then be related to that one change. Too many changes tell you nothing.



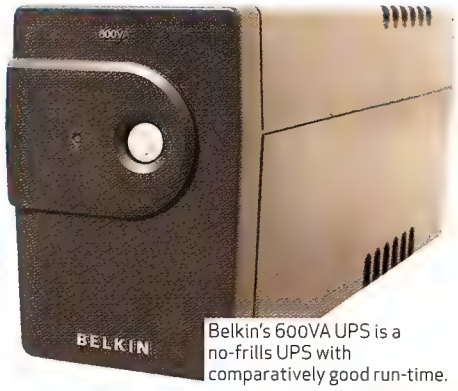
Integrated audio all buzz? Try this Burr-Brown powered MUSE X5 DAC.



Replace dead USB ports using this $4 four-port rear bracket from eBay.

PC hardware upgrade secrets

Getting more performance from your PC doesn't have to cost as much as you think. Darren Yates shares his upgrading secrets.



Belkin's 600VA UPS is a no-frills UPS with comparatively good run-time.

THE $0 SYSTEM UPGRADE

Give your PC an early spring clean and refresh your Windows OS installation. It's an unwritten law that PC performance is inversely proportional to the age of the OS install and I've always been surprised how much more smoothly a clean OS can perform. We all install crapware and forget about it, but if that crapware is forcing Windows to preload junk on boot-up, it'll likely be slowing your PC for no real reason. If you don't have time for a complete reinstall, at least check your Programs and Features list of rubbishware you no longer need and grab back some system resources.

Android is an ideal OS to run on older hardware. See **android-x86.org**.

THE $20 SYSTEM UPGRADE

Actually, we'll give you a bonus upgrade option in this one. I've gathered a few SSDs over time and I've found nothing faster for accessing files I need than a low-cost USB-to-SATA adapter. The USB connector delivers data and power connectivity from the PC and the SATA port plugs straight into the back of the drive. You'll find USB 2.0 versions for as little as US$3 on eBay, or just get the USB 3.0 option for US$5. If your PC doesn't have USB 3.0, get it with a $20 USB 3.0 PCI-E expansion card – it'll make all the difference using the latest external hard drives as well.

THE $40 SYSTEM UPGRADE

If you're like me, you think nothing of opening a few dozen new web browser tabs as the mood takes you. Problem is, with too little RAM to start with, your system can begin to suffer. Adding 4GB of RAM, provided you have a 64-bit version of Windows, will enable you to open more apps and files before the system pagefile needs to be called in – and the less you need the pagefile, the more everyone wins. Your PC's CPU won't process code faster, but it won't need to swap out data as much, so it'll maintain its native speed for longer. A 4GB stick should cost around $40-$45.

THE $60 SYSTEM UPGRADE

Whenever I upgrade my PC, I always start with a fresh hard drive/SSD and keep the old hard drive as an instant backup. To grab needed files, I plug the drive straight into a dual-bay USB 3.0 SATA drive dock. You'll find them for under $60. Having end-to-end USB 3.0 is the key to maximising data transfer speeds. But what's great about having one of these devices is that it allows you to keep your internal storage clean of files you don't necessarily need permanent access to. If you use an SSD as your system drive, the less you store on it, the longer it'll last, so having ready-made backups works for me.

THE $80 SYSTEM UPGRADE

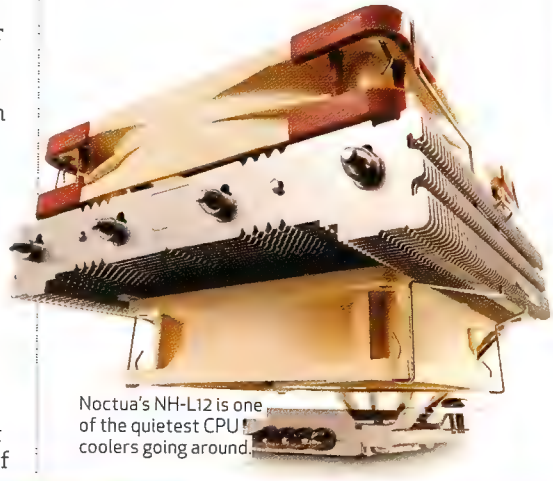
Need something to speed up your old PC, but on a tight budget? Grab Kingston's 120GB V300 SSDNow SSD for under $80 online and make it your PC's new system drive. Keep your old hard drive as secondary storage and use the SSD for OS and apps only. Even with only a SATA2 port, a budget SSD will boot your system faster than a hard disk drive and give it more responsiveness. Given how difficult it is to do a CPU upgrade on most PCs older than 12 months these days, it's the cheapest way to give your PC a perceived performance lift.

BUDGET HARD-CORE SPEED FOR $100

Intel's Pentium G3258 is Intel's budget dual-core desktop CPU, but with lots of overclocking potential. How much? Reports are it'll easily jump from its stock 3.2GHz rate to 4.5GHz, even 4.8GHz. For around $100, it delivers overclocked single-thread performance that goes close to a quad-core Core i7-4790K. A great little upgrade starter.

SILENCING YOUR PC — #1

Building a home theatre PC, there's nothing worse than a noisy PSU fan. Fanless PSUs aren't cheap but they do exist. Seasonic is our go-to PSU brand, so check out the 400-watt Platinum P-400 for just under $200 or the


Noctua's NH-L12 is one of the quietest CPU coolers going around.

Fanless PSUs aren't common but do exist — Seasonic's X460 costs $230.

This USB-to-SATA adapter makes it easy to grab files from SSDs lying around.

460-watt Platinum X-460 for around $220. We wouldn't choose it for gaming, but its fine for a home theatre/server.

SILENCING YOUR PC — #2

The CPU heatsink-fan is the other issue. Again, we're partial to Noctua CPU coolers and one of the quietest options is the NH-L12. It's not cheap at around $90 and it's not suitable for overclocked systems or any CPU with a 95-watt or greater TDP rating, but at low operating voltage, the fan here barely operates beyond a whisper (around 12dBA).

DUAL MONITORS ON INTEGRATED GRAPHICS

You don't need a dedicated graphics card to get multi-monitor support — Intel's integrated HD Graphics GPU has supported at least two monitors since Sandy Bridge (Core iX-2000 series). We wouldn't game with it, but for coding, doing spreadsheets or other office work, it should work nicely (provided your board has two integrated video outputs, of course).

BEST MINI-ITX CASE FOR $100

There's a mini-boom in Mini-ITX cases at the moment, but we keep coming back to the BitFenix Prodigy. Just this side of $100, it handles tall CPU coolers (even a Noctua NH-D14), PSUs up to 160-millimetres long and GPU cards to 320-millimetres. It's not the most compact, but still one of the more versatile Mini-ITX cases you'll find.

BACKUP YOUR POWER SUPPLY

One of the inherent bonuses notebooks have is battery backup. If AC mains power is lost on a desktop PC, everything you haven't saved previously is gone. An uninterruptible power supply (UPS) will give a typical 120-watt desktop PC around 20 minutes of extra power to shut down gracefully. Belkin's 600VA UPS costs under $100 at Officeworks.

> "We wouldn't choose it for gaming, but its fine for a home theatre/server."

KEEP YOUR OLD DRIVES

If you're upgrading your system, start with a fresh hard drive in addition to a new SSD, but keep the old drives as ready-made backups. With new 1TB drives selling for $60, it's not worth forcing old drives to go around the mill again. Besides, dumping old drives is a data security risk at the best of times.

THE $1 AUDIO DAC

Audio quality on some budget motherboards in recent years has gone 'down-hill'. I picked up a USB DAC based on C-Media's CM108 chip (**tinyurl.com/obygy8p**) from eBay and although not perfect, it's much better than my on-board audio. Best of all, it cost me just US$1 — including shipping! Just eBay-search for 'USB sound card'.

DITCH WINDOWS FOR ANDROID

Run Android KitKat/4.4 on your x86 PC free, thanks to the Android-x86 project (**tinyurl.com/pbl4ryt**). It comes as an ISO image you install to a USB flash drive with UNetbootin (**unetbootin.sourceforge.net**). Grab an old 64GB SSD, install KitKat from the USB drive and you're away. It won't likely have drivers for everything, but it still works exceptionally well.

GET 1GBPS SSD WRITE SPEEDS

Grab two identical 500MB-per-second (500MB/s) or faster SSDs, run them in RAID0 on late-model Intel H- or Z-series motherboards via the on-board RAID and use at least Windows 7 operating system. Not ideal for long-term or important storage, but we hit the 1GB/s sequential-write mark with two 120GB Kingston HyperX 3K SSDs on an H77-chipset board.

A 4GB RAM stick is a low-cost upgrade to ease the load on your PC.

Kingston's 120GB V300 SSDnow SSD for $80 online is a great budget upgrade.

PC hardware maintenance secrets

It's your pride-and-joy, so maintenance is important. Darren Yates gives you his hit list of things to watch out for.

Make sure your IEC mains cable is firmly fitted — if not, your PSU may burn out.

KEEP THE CPU COOLER CLEAN

Nothing robs your PC of speed like an overheating CPU. I managed to even surprise myself recently when I noticed dust gathering underneath the CPU fan above the heatsink fins on my CPU cooler — surprising because the PC is a good metre off the floor. No matter how much you vacuum carpeted floors, dust will eventually clog up the heatsink or filters on your PC case — naturally dusty environments don't help either. With no airflow, you get no cooling, CPU temps rise and performance drops off a cliff. Do a six-monthly check just to make sure your PC thermally stays in good condition.

CHECK YOUR MAINS CABLE REGULARLY

I had to learn this one the hard way recently. Having added a new external peripheral to a PC, I didn't notice that I'd bumped the AC mains cable. A few days later, the acrid smell of burning electronics revealed the PSU had popped and the AC mains cable plug was damn warm! We've found that the fit of some IEC mains cables isn't great and they do not grab as well as they should. Any time you muck around behind your PC, make sure the AC mains cable is firmly in place — even if you think you haven't touched it. Otherwise, it might cost you a small fortune.

TEST YOUR BACKUPS!

We shouldn't have to mention this one, but if you haven't performed a system backup lately, consider this a timely kick up the bum! We're all overloaded with things to do, so it's easy to put off. Personally, I use but don't rely on cloud storage — I want to make sure I can get to all of my files without needing a web connection. Even if you just use external hard drives, that's better than nothing at all. But more importantly, make sure that you can restore your backups, whatever system you use — a backup you haven't tested is almost worse than no backup at all.

TEST YOUR UPS

If you run your PC via an uninterruptible power supply (UPS), it's a good idea to just check it every six months or so to ensure that the internal SLA (sealed-lead-acid) battery is still in good working order. Australia generally has dependable AC power, so it's only freak weather conditions or accidents that will likely take it out — that means the UPS is unlikely to be used often. Just turn the AC mains switch off, check that your PC continues running and time it out occasionally. SLA batteries don't suffer memory-effect issues, but better to know of problems before you need your UPS to do its thing.

MAKE A USB RECOVERY DRIVE

It shouldn't happen, but if your Windows 8.1 install goes pear-shaped, it may be difficult to get into recovery mode, particularly if you don't have access to Windows on physical media. Head to Microsoft's web site (**tinyurl.com/pwb9gmh**) and learn how to create a recovery disk on a USB flash drive. It'll give you essential repair tools that might just get your system back up and running without too many dramas. Better still, keep your Windows OS ISO image installer on a USB flash drive so that it's ready to use at a moment's notice (you'll find recovery tools built into the installer).

This CPU cooler came from a Pentium 4 PC not cleaned in three years.

KNOW HOW LONG YOUR UPS LASTS

Knowing your UPS still works is important — but so is knowing how long it'll run. Don't trust the marketer's time ratings — every PC setup is different and you should test your UPS so that you know within a minute or

I don't keep hard drives as front-line devices beyond two years. Not worth it.

two how long you've got in your setup before it gives out.

REFRESH THE CPU COOLER THERMAL PASTE

It's also a good idea to occasionally refresh the thermal paste between your CPU and cooler. Over time, the paste can dry out and lose its transfer properties, reducing cooling efficiency. Cleaning the CPU heat spreader and replacing the paste, especially after a hot summer or prolonged overclocking, will ensure it maintains peak cooling.

BEST WAY TO CLEAN YOUR SCREEN

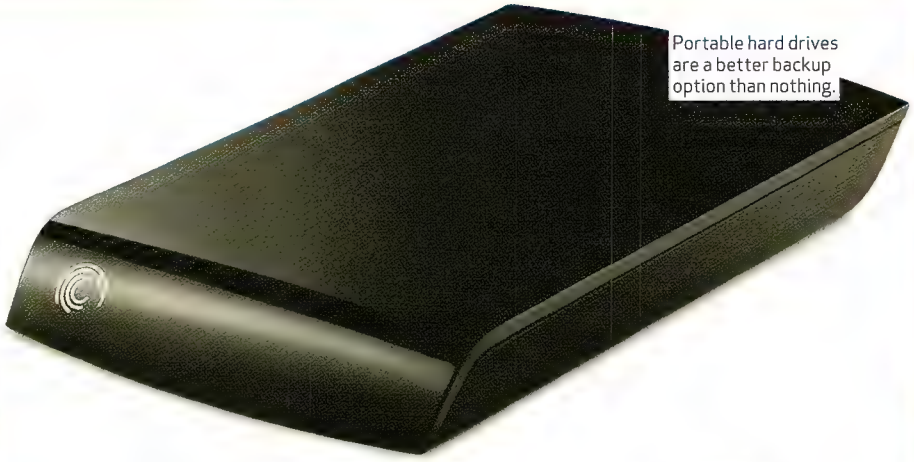
Screens don't need help getting dirty, let alone touchscreens. GorillaGlass is great for portable devices but few LCD monitors get this stuff. Gently use a dry microfibre cloth like the ones used for cleaning your specs for best results. Avoid using liquids of any kind – they can damage the panel surface but more importantly, liquids and electricity don't mix.

REPLACE HDDS EVERY TWO YEARS

It's all too easy to run hard drives into the ground. That's why I never run a hard drive more than two years – even if it's working perfectly. Better to rebuild a system when it's convenient than try to solve a failure in a panic. It's also why I prefer 1TB drives – large enough to be useful, cheap enough to replace.

BE KIND TO YOUR POWER BRICKS

In a hurry, it's tempting to roll up your notebook power brick cables like winding a ball of string, but that's the best way to strain the connectors and cause faults. I've seen this numerous times. Fold the cable using its natural kinks and some Velcro/hook and loop tape to keep things under control.



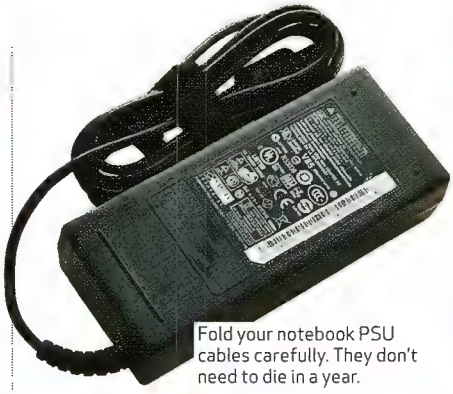
Portable hard drives are a better backup option than nothing.

DON'T STRAIN NOTEBOOK PORTS

Notebook internal ports such as USB and Ethernet connectors are soldered straight to the motherboard – that means they won't take much rough treatment before they crack, either. Be careful not to strain the ports laterally or longitudinally and give cables as much slack as you can. Notebook port repairs don't come cheap.

KEEP YOUR INSTALLER FILES SECURE

None of the device driver software I use comes on physical media, so it's important to keep track of installer files in case I need to reinstall the software. It's also why I always look for full-download files, rather than download-managed installers. Keeping your device driver files secure will make it far easier to get your system back up and running.



Fold your notebook PSU cables carefully. They don't need to die in a year.

UNPLUG YOUR PC DURING A STORM

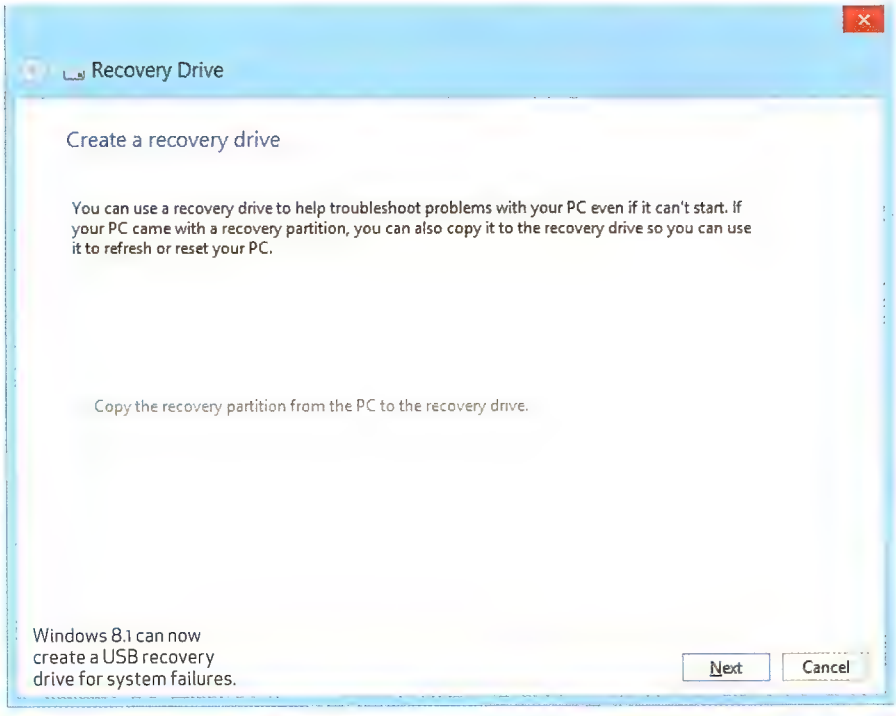
This one comes under 'preventative maintenance', but it's always a good idea wherever possible to unplug your PC during a thunderstorm. Personally, I prefer not to rely on surge-protected powerboards – they may well work but I don't want to have to find out. Power surges can't hit a PC that's not plugged into the mains.

CHECK THE PSU FAN

Just as you should be checking the CPU cooler for dust, the same holds for the power supply unit (PSU). If the PSU overheats, it'll likely pop without warning, taking much of your PC with it (which is why I keep a spare). Ensure you remove the AC power first and don't poke anything inside it – there could still be nasty high-voltages floating around.

NOTEBOOKS IN BED

We've all done it – thrown the notebook on the bed on a lazy Sunday afternoon to watch Netflix – but it's not a good idea. If you accidentally cover up the notebook's air in-take vents, you reduce its cooling ability. That increases heat, reduces performance and battery life. Grab a hard-covered book at least and rest it on that.


Recovery Drive
Create a recovery drive
You can use a recovery drive to help troubleshoot problems with your PC even if it can't start. If your PC came with a recovery partition, you can also copy it to the recovery drive so you can use it to refresh or reset your PC.
Copy the recovery partition from the PC to the recovery drive.
Windows 8.1 can now create a USB recovery drive for system failures.
Next
Cancel

Windows secrets

Unravelling the secrets of Windows takes a sharp mind and a steel hand and… oh who are we kidding. Everyone has a handful of their own tips and tricks from experience; here are Ashton Mills'!

CHECK YOUR RELIABILITY

Windows 8 has an excellent tool to help you visualise the reliability of your PC and drill-down into the events which may be affecting stability, both of the OS and the programs you run. This one's under the Action Center from the Control Panel, after first clicking the Maintenance drop down. You'll see 'View reliability history', click to launch. You'll see a graph that you can view by days or weeks showcasing system warnings, failures and program crashes. Click on a day to view the events, and then click on an event to learn more about it. For some issues, you may also be able to search for solutions online.

UNDO EXPLORER

Ctrl-Z undo isn't just for Word or Paint, it works in Explorer too – if you've just gone and deleted, or even moved, a bunch of files by accident then no worries – Ctrl-Z will restore it.

KEEP IT ORGANISED

As you install more and more programs, you may find your Start Screen becoming cluttered. No worries! Windows 8.1 will let you organise them into groups: just drag a program to an empty space to create a new group. Then, right-click somewhere in the same empty space and select 'Name groups' to give the new group a name.

HISTORY LESSON

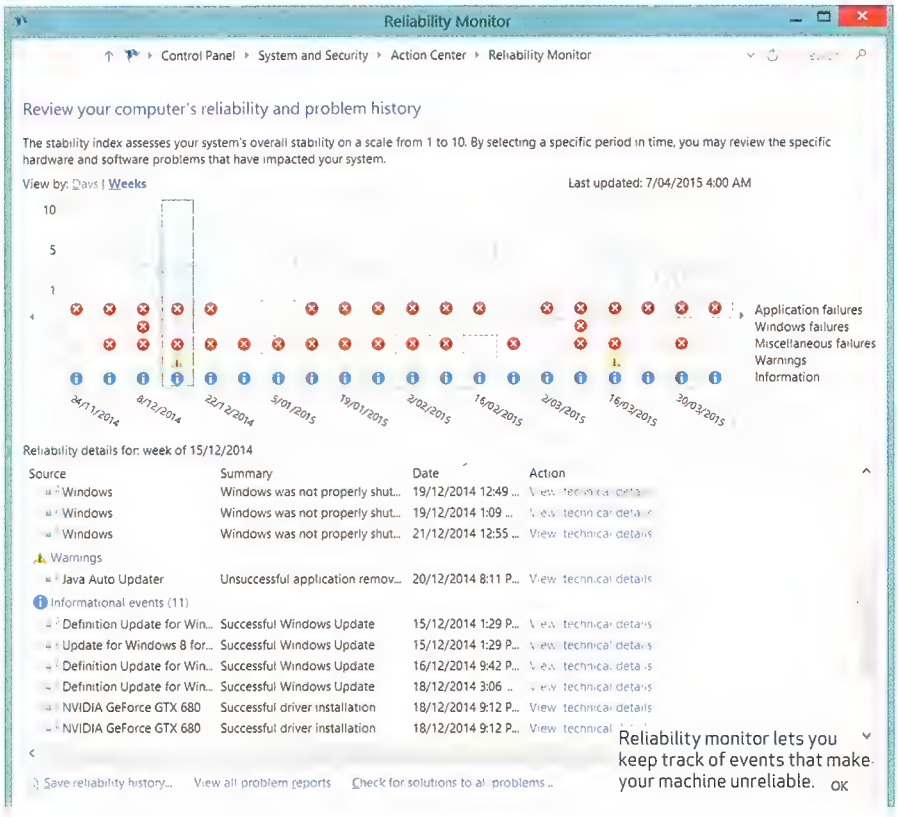
It took Microsoft until Windows 8 to add a decent in-built backup tool, and it's a cracker – if you're not using File History, you should be. From the Control Panel go to 'System and Security > File History'. Choose a backup location on a different hard drive (internal or external), or even a network share. Set desired disk usage under Advanced Settings, and you're done. It'll not only backup your personal files, it'll keep versions of them saved every hour.

X MARKS THE SPOT

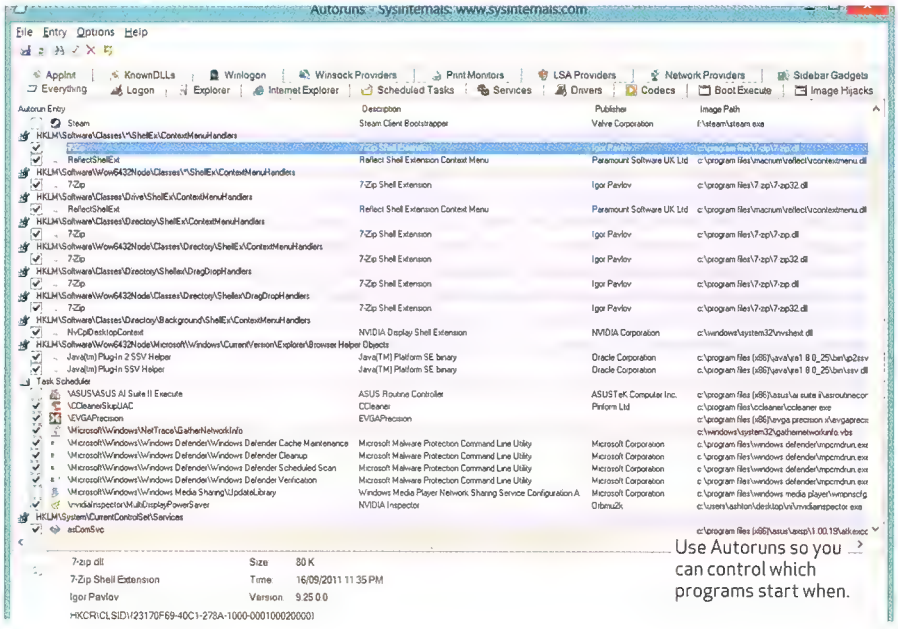
Simple, fast, and easy – the ultimate key combination: Win-X, and up pops the Power User menu (also accessible by right-clicking in the very lower-left of your Windows 8 or 8.1 desktop).

SNEAKY START-UPS

Inevitably you'll end up installing programs that force themselves upon you (lookin' at you Adobe, Apple, Samsung… oh bugger it, all of you tech giants). Disable unwanted start-ups first with Task Manager (Ctrl-Alt-Delete, then click the Startup tab)



Reliability monitor lets you keep track of events that make your machine unreliable. OK



Use Autoruns so you can control which programs start when.

or, for the nuclear option (you'll see when you check it out), type 'autoruns' into Google, download the Sysinternals 'Autoruns' program, and go wild.

SMARTER SNAPS

You already know that pressing PrtScrn will take a snapshot of your desktop (you *did* know that) and put it in the copy/paste buffer so you can Ctrl-V it into Paint or another program to save. But who needs all that exercise of the extra step? Press Win-PrtScrn and Windows 8 will save it directly to your My Pictures folder as a .PNG. But wait, there's more! No, not the steak knives, but almost as good: why capture a whole desktop if you only want one window? Press Alt-PrtScrn to capture just the highlighted window. Unfortunately, you can't do Win-Alt-PrtScrn, so you'll still have to paste the window shot into Paint before saving (come on Microsoft! Get with the program!).

NOT NOW, FIDO

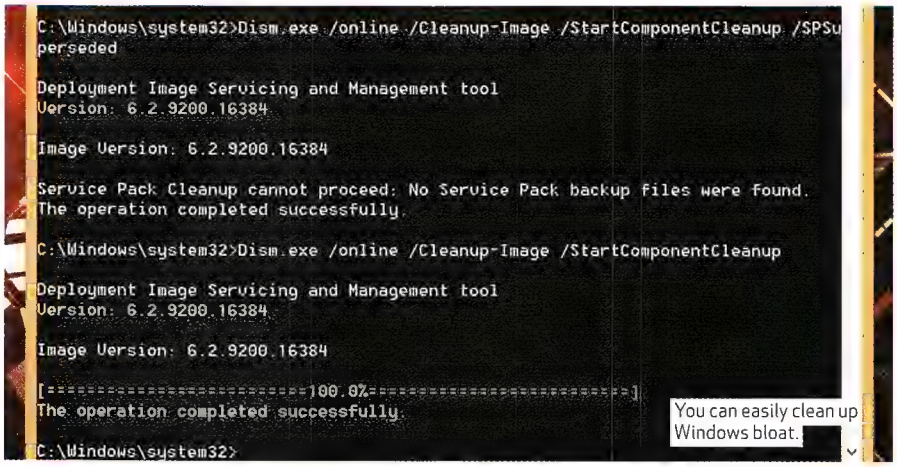
It's easy to miss but if you head to 'Change PC Settings' from the Charm bar Settings, then click on 'Search and apps', and finally 'Notifications' you'll find the Quiet hours option – where you can tell Windows when it can and can't bug you with notifications.

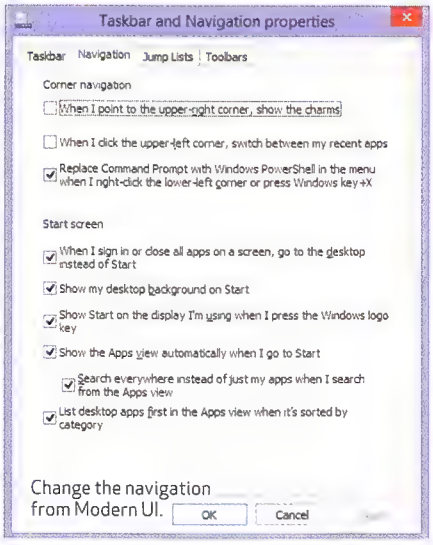
MINE, NOT YOURS

If you care about *not* sharing the intimate relationship between you and Windows with the world (oh OK, and probably your personal data) click on Privacy also found under PC Settings, and toggle off those sharing options accordingly.

SPACE SAVERS

Windows is still king of the bloat, and while there's CCleaner and Disk Cleanup (right-click on a drive > Properties), these won't get everything. Reclaim what is often gigabytes of space from Windows Update and Windows Service Pack backups by first opening an Administrator command prompt (search for 'cmd', right-click on Command Prompt, and select 'Run as Administrator'), then running: `dism.exe /online /Cleanup-Image /StartComponentCleanup`. If you're using Windows 8.1, you can add `/ResetBase` to the end of that line, too. After that completes, replace `/ResetBase` with `/SPSuperseded` and run it again. Next, clean up old Shadow Copy (used for everything from backup driver installs to System Restore) data with: `vssadmin Resize ShadowStorage /On=C: /For=C: /MaxSize=10GB` changing the MaxSize to be about 10% of your drive. In one Windows 7 test system, this freed up 30GB! Finally, search for 'restore' and create a new System Restore snapshot.


C:\Windows\system32>Dism.exe /online /Cleanup-Image /StartComponentCleanup /SPSuperseded
Deployment Image Servicing and Management tool
Version: 6.2.9200.16384
Image Version: 6.2.9200.16384
Service Pack Cleanup cannot proceed: No Service Pack backup files were found.
The operation completed successfully.
C:\Windows\system32>Dism.exe /online /Cleanup-Image /StartComponentCleanup
Deployment Image Servicing and Management tool
Version: 6.2.9200.16384
Image Version: 6.2.9200.16384
[==========100.0%==========]
The operation completed successfully.
C:\Windows\system32>
You can easily clean up Windows bloat.


Taskbar and Navigation properties
Taskbar
Navigation
Jump Lists
Toolbars
Corner navigation
When I point to the upper-right corner, show the charms
When I click the upper-left corner, switch between my recent apps
Replace Command Prompt with Windows PowerShell in the menu when I right-click the lower-left corner or press Windows key+X
Start screen
When I sign in or close all apps on a screen, go to the desktop instead of Start
Show my desktop background on Start
Show Start on the display I'm using when I press the Windows logo key
Show the Apps view automatically when I go to Start
Search everywhere instead of just my apps when I search from the Apps view
List desktop apps first in the Apps view when it's sorted by category
Change the navigation from Modern UI.
OK
Cancel

SECRET SEND-TO

No, not Secret Santa but secret *Send-to* – the aptly titled feature usually shows just a handful of options from zipping to mailing. But hold Shift before right-clicking, and then selecting 'Send to' and you'll be presented with considerably more choices.

MANAGING MAINTENANCE

Windows 8 and 8.1 does a better job than previous Windows versions at keeping your system humming smoothly. Part of this is the automated background maintenance (and includes virus scans, File History backup, TRIMing and more). But it may not always run at the best time for you – so here's how to change it: open the Action Center and then, under Maintenance, click on 'Change maintenance settings' and choose a time to suit.

SHIFTING TO SAFE MODE

Any battle-scarred geek will have used (or *needed*) the F8 safe mode at one time or another. It's still there in Windows 8, but to access it you need to hold down Shift+F8 just before Windows boots. Awww, look at the pretty blue...

DESKTOP 4EVA

Modern UI takes some getting used to, but Windows 8.1 makes it easier to simply ignore it and be a desktop junkie. Hit 'Win-D' to go to the Desktop, right-click on the task bar, select Properties, and slam your trigger finger on Navigation. Bask in desktop-friendly options Microsoft deigned to supply.

WIPE IT FREE

Windows 8 is particularly good at helping you recover from disaster, including its more modernised advanced startup menu (hold down Shift while clicking Restart from the Power Charm) and its 'Refresh your PC' option to keep personal data while re-installing Windows. But what about the opposite, say running a wipe before you pass your PC on to a better cause? From the same menu you can also opt for 'Remove everything and re-install Windows'. You'll need a Windows 8 or 8.1 install disk and, when prompted, you'll have two options: 'Just remove my files' for a quick solution if the PC is just going to a family member, or 'Fully clean drive': this performs both a delete and a full disk wipe with random data, which may take a several hours, before re-installing Windows fresh.

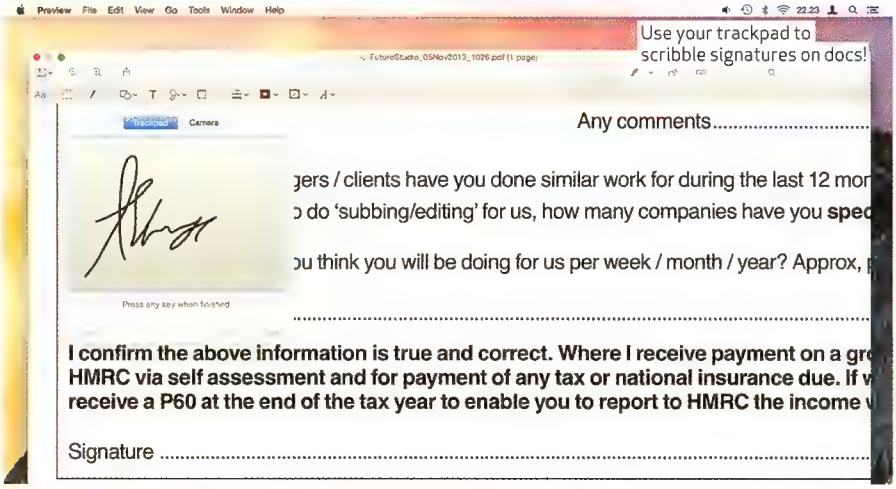
"Windows is still king of the bloat, and while there's CCleaner and Disk Cleanup, these won't get everything."

Mac secrets

OS X may be billed as 'easy to use' but there are still plenty of tweaks and tips to make it better. Here are the APC team's favourites for wringing more from Yosemite (OS X 10.10).

PAPERLESS DOCUMENT SIGNING

You no longer need to hold up a signed piece of paper to a Mac's camera to capture your signature and add it to a PDF. Yosemite makes it possible by moving your finger on a trackpad – and documents can be signed in Mail, not just Preview. In Finder, move the pointer over the preview of a PDF attachment and click the icon that appears at its top right to start using Markup to create and add your signature. Your signature is synced to your iCloud account to make it available on all of your Macs signed into that account.



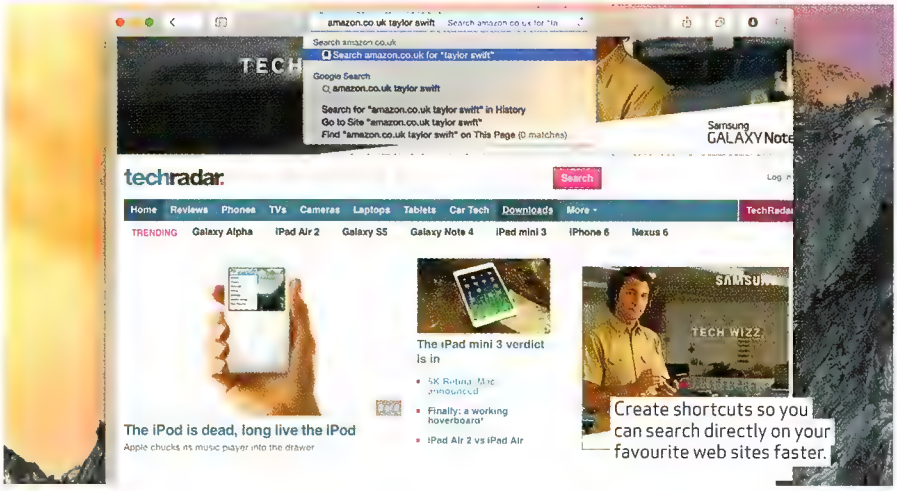
BATCH RENAME FILES IN FINDER

There's no need to resort to Automator or to download an app to rename a bunch of files any more – it's all possible from Finder. Select several files, then right-click on one and choose the item with the label 'Rename [number] items'. The existing filenames can be: prefixed or suffixed with additional text; you can search for and replace something in them; or you can change all of them to the same format with a number or the current date and time added before or after.

QUICK WEB SITE SEARCH IN SAFARI

When you use a site's built-in search engine, Safari takes note of the formatting of its search results page's address – specifically the query string at the end of it, which contains what you typed. Try it now by searching for something on Amazon and you'll notice the site becomes listed in Safari's preferences under 'Search > Enable Quick Website Search > Manage Websites...'. You're now able to search Amazon without having to go to the site and type into its search bar.

Try this out by typing "amazon.com taylor swift" (without the quotes) into Safari's search field, but don't press Return. The first suggestion listed, which you can reach by pressing the down arrow key, submits your keywords directly to the site's search engine. Typing full domain names to get this to work can get tiresome, so use the Text tab in System Preferences Keyboard pane to create shorter acronyms that expand into them. For example, we've set #ama to expand into amazon.com, so all we need to type for the previous example is "#ama taylor swift". Remember, your text expansion shortcuts sync via iCloud, so any you set up can also be used for this purpose in iOS 8's version of Safari.


techradar
The iPod is dead, long live the iPod
The iPad mini 3 verdict is in
Create shortcuts so you can search directly on your favourite web sites faster.

CLOSE SAFARI TABS LEFT OPEN ON OTHER DEVICES

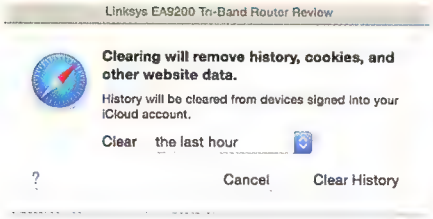
Did you leave a tab open on your iPad after booking a surprise for someone, only to then hand that device to them? You can close tabs from your Mac if it's signed into the same iCloud account. Choose 'View > Show All Tabs' (or pinch two fingers together on a trackpad). Below the thumbnails of the tabs open on your Mac is a list of 'iCloud Tabs' on your other devices. Move the pointer over one of them and click the cross that appears to its right to close it.

SHOW THE FULL WEB ADDRESS

In its constant effort to take away any and all distractions from the browsing experience, Apple has stripped the web address down to its barest essentials in the latest version of Safari. Instead of a lengthy URL with hyphens and slashes, Safari on Yosemite only shows you the site you're on until you click into the address field. If you want to see the whole address without clicking, however, head over to the Advanced tab in Safari's preferences to turn it on.

MORE PRIVATE BROWSING OPTIONS

Like most modern browsers, Safari contains a private browsing mode that


Linksys EA9200 Tri-Band Router Review
Clearing will remove history, cookies, and other website data.
History will be cleared from devices signed into your iCloud account.
Clear the last hour
Cancel
Clear History

Scrub the traces of your most-recent web browsing with this new option in Safari.

enables you to surf without leaving traces. If you forget to browse in a private window and need to cover your tracks, the Clear History and Website Data… item in Safari's app menu and History menu, is more helpful, as it no longer clears your entire web history. In Yosemite it provides options to clear the last hour's browsing, all of today's, or today's and yesterday's. Now you can be much more forensic about erasing your footsteps!

CONTROL WHICH DEVICES RECEIVE PHONE CALLS

Call forwarding from your iPhone is a nice modern convenience that's available through the FaceTime apps on iOS 8 and Yosemite. But perhaps you don't want to receive phone calls on your Mac, or else only on some of your devices in addition to your iPhone (we now exactly what it's like to have all your devices going off at once!) Under Settings in FaceTime's preferences, the checkbox labelled 'iPhone Cellular Calls' determines whether calls will come through to the Mac you're using. On your iPad or iPod touch, the same option is found in 'Settings > FaceTime'. You will of course have to be running iOS 8.

ASSIGN ALERT TONES TO CONTACTS

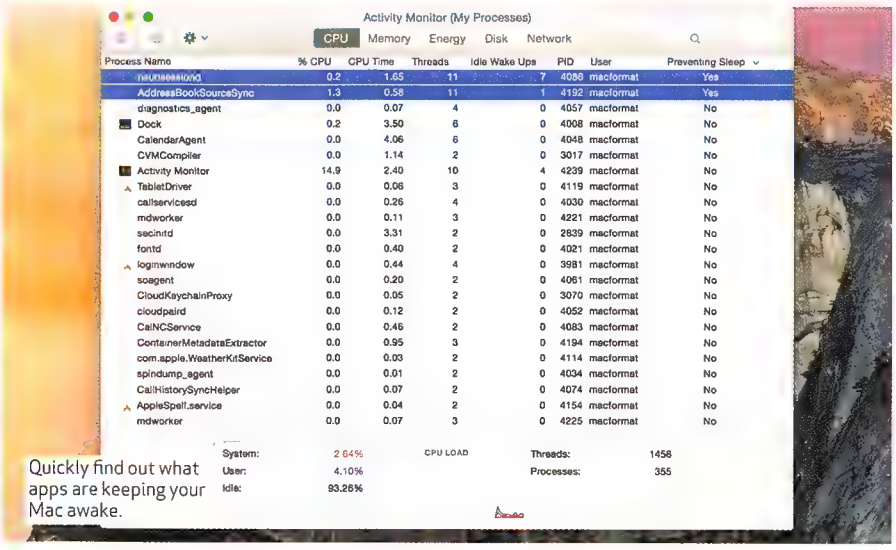
Now that Macs can receive phone calls, they've been provided with the same set of ringtones as iOS which you can assign to people in the Contacts app. This means you can tell who's calling even if you're away from the screen. As with other details about contacts, ringtone assignments are synced via iCloud to your other devices. Sadly, there's no option to assign custom ringtones, though.

SEE WHAT'S PREVENTING SLEEP

If you're having trouble putting your Mac to sleep, right-click a column heading in Activity Monitor and choose the new Power Assertion item. This adds a column that's actually headed 'Preventing Sleep' and which contains simple 'Yes' and 'No' values that quickly identify culprits.

SCREEN SHARING IN MESSAGES

Click Details at the top-right of an iMessage conversation and, next to the phone and video icons, you'll see an icon that resembles two overlapping rectangles. Click it to find options for sharing your Mac screen with the contact, and to request to see their screen – handy for helping out with technical problems.


Activity Monitor (My Processes)
CPU
Memory
Energy
Disk
Network
Process Name
% CPU
CPU Time
Threads
Idle Wake Ups
PID
User
Preventing Sleep
powerd 0.2 1.65 11 7 4086 macformat Yes
AddressBookSourceSync 1.3 0.58 11 1 4192 macformat Yes
diagnostics_agent 0.0 0.07 4 0 4057 macformat No
Dock 0.2 3.50 6 0 4008 macformat No
CalendarAgent 0.0 4.06 6 0 4048 macformat No
CVMCompiler 0.0 1.14 2 0 3017 macformat No
Activity Monitor 14.9 2.40 10 4 4239 macformat No
TabletDriver 0.0 0.06 3 0 4119 macformat No
callservicesd 0.0 0.26 4 0 4030 macformat No
mdworker 0.0 0.11 3 0 4221 macformat No
secinitd 0.0 3.31 2 0 2839 macformat No
fontd 0.0 0.40 2 0 4021 macformat No
loginwindow 0.0 0.44 4 0 3981 macformat No
soagent 0.0 0.20 2 0 4061 macformat No
CloudKeychainProxy 0.0 0.05 2 0 3070 macformat No
cloudpaird 0.0 0.12 2 0 4052 macformat No
CalNCService 0.0 0.46 2 0 4083 macformat No
ContainerMetadataExtractor 0.0 0.95 3 0 4194 macformat No
com.apple.WeatherKitService 0.0 0.03 2 0 4114 macformat No
spindump_agent 0.0 0.01 2 0 4034 macformat No
CallHistorySyncHelper 0.0 0.07 2 0 4074 macformat No
AppleSpell.service 0.0 0.04 2 0 4154 macformat No
mdworker 0.0 0.07 3 0 4225 macformat No
System: 2.64%
User: 4.10%
Idle: 93.26%
CPU LOAD
Threads: 1458
Processes: 355

Quickly find out what apps are keeping your Mac awake.

Apple's made capturing your iOS screen to video incredibly easy in Yosemite

> "Click Details at the top-right of an iMessage conversation to activate Do Not Disturb for that thread alone"

MUTE CONVERSATION NOTIFICATIONS

Click Details at the top-right of an iMessage conversation to activate Do Not Disturb for that thread alone. This setting persists until you return to the conversation and turn it off. You can tell who is muted, as you will see a moon icon to their left in Messages' main window.

RECORD YOUR IOS SCREEN

Yosemite includes an easy way for app developers to record video and audio of their iOS apps, and it's available to you as well. It's a great way to show off your game skills, and send a video to a friend to show them how to do something. Connect your iOS 8 device to your Mac using its Lightning-to-USB cable. Open QuickTime and choose 'File > New Movie Recording'. Click the arrow to the right of the record button and choose your iOS device's name from the available cameras, and under microphones if you want to record its audio as well. Press the red button to start recording.

Linux secrets

Linux has more secrets hiding in its selectable depths than in the collective belly of a colony of robust and affable penguins. Ashton Mills couldn't catch any penguins to divulge their secrets, so here's some of his instead!

MIRROR MIRROR

Ubuntu and Ubuntu-based distributions have a neat little feature in the software updater that lets you not only choose a closer mirror for updates, but benchmark to find the fastest,thereby saving you precious time when it comes to updating. For Ubuntu head to 'System Settings > Software & Updates' and then in the 'Download from' box select Other. You can select Australia or click on 'Choose Best Server' to allow Ubuntu to ping the fastest. This will bring up a list where you can manually select a server in Australia, or optionally click 'Select Best Server' and Ubuntu will ping to find the best.

TRIM THE FAT

SSDs are a modern marvel, and while they don't need to be defragmented they do need to be trimmed to keep them in good order. Under Linux this can be done with the `fstrim` command. Simply run `fstrim -v /` to TRIM your root filesystem, just as in Windows (through the Optimise panel on a drive's Properties). You can also add the 'discard' flag to your /etc/fstab file to have the Linux kernel automatically TRIM on the fly. Just `nano -w /etc/fstab` and add it after the re-mount flag so it reads 'remount-ro,discard'.

PRIVACY, PLEASE

As Ubuntu gained in popularity, its also succumbed to the corporate juggernaut somewhat – parts of it have been monetised, such as the inclusion of the Amazon link as well as sending your search results from the Dash to third parties (and why you may see paid products under 'Suggestions'). If this bothers you it can all be easily removed thanks to a helpful script from **fixubuntu.com**. Check out the site for more info, or fetch and run it with the following command: `wget -q -O - https://fixubuntu.com/fixubuntu.sh | bash`

FIREWALL WITH FLAIR

Linux comes with its own firewall built into the kernel, and distributions like Ubuntu make it easier to configure with `ufw`, aka Uncomplicated Firewall. However this is a command-line utility. For an easier GUI version, try `apt-get install gufw`.

SPRING CLEANING

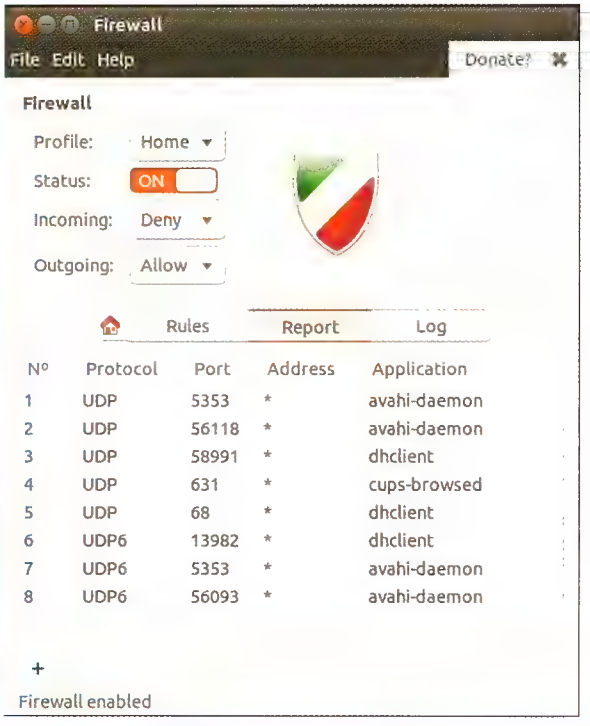
The apt program manager can clean-up downloaded and unnecessary packages with `sudo apt-get autoremove && sudo apt-get clean`, but for more fine-grained control there's Linux's answer to CCleaner: `sudo apt-get install bleachbit`.

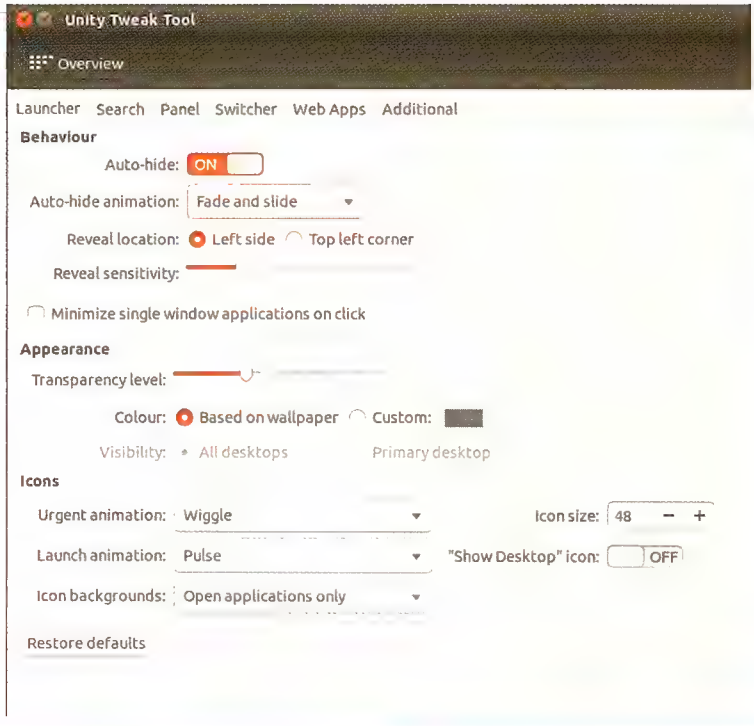
CHECK PLEASE, WAITER

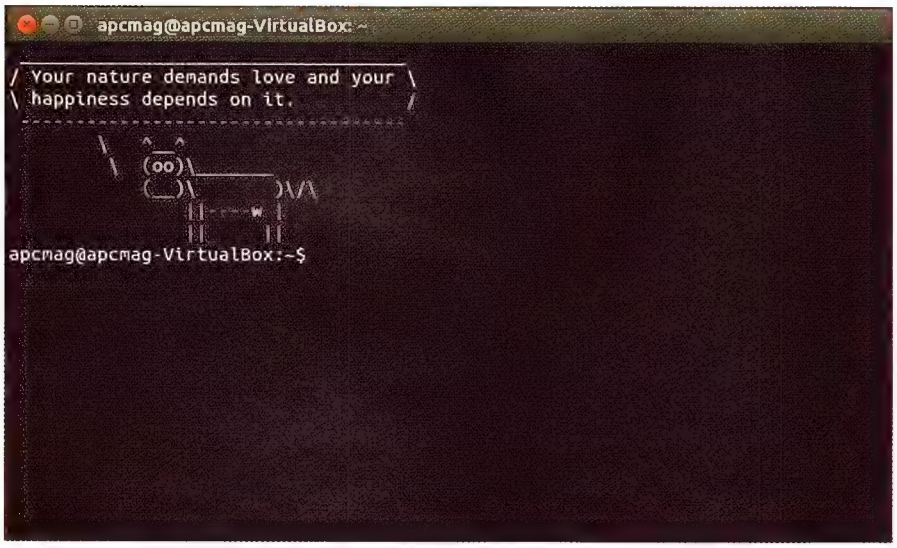
By default your distribution will be set up to check the drive once every 30 reboots or so. But being Linux, you may not reboot that often or you may have other reasons to force a check, like a sudden power loss to the system. You can't check and fix errors on a mounted root filesystem, however, so how do you go about forcing a disk check? There are many ways but perhaps the easiest is simply this: open up a terminal and type `sudo touch /forcefsck && sudo reboot`.

KEEPING UP TO SPEED

All devices need to be identified so that they can be properly configured. In Linux, databases for PCI and USB unique identifiers are often updated







"This gem will analyse your usage and over time automatically load your most used programs into memory at boot."

when a distribution packages a new release. However, you can update them for your devices with the latest definitions sooner by running `sudo update-pciids && sudo update-usbids`.

OINK OINK

Short on disk space? Just type 'disk' into Ubunutu's Dash to find the Disk Usage Analyser to reveal your disk-hungry data directories, and for finding phat packages you've installed run `dpigs` in a terminal. You may need to install it first with `apt-get install debian-goodies`.

FASTER, PUSSYCAT!

Speed up your application loading with the wonderfully helpful `preload`. This little gem will analyse your usage and over time automatically load your most used programs into memory at boot. Great for older systems still using HDDs, but even SSD users can benefit. It's fire and forget with `apt-get install preload`.

MORE OR LESS

If you've spent any time at the command-line on Linux or even Windows, you'll know about piping output via `more` to let you browse through output one page at a time. But in a case where less is more, using the `less` command instead is *more* versatile allowing you to scroll back and forth as well one page or one line at a time.

YOU HAVE MESSAGES

Sometimes you might see some text fly past during boot, or want to see exactly what's happening before and after Linux loads. For kernel messages, simply type `dmesg` at a terminal (perhaps paired with a `|less` or a `grep`). For system-wide messages, try `cat /var/log/syslog |less`. Alternatively, enter 'log' into Ubuntu's Dash for the System log viewer.

GET TWEAKING

There are a variety of tweak tools available including `gnome-tweak-tool` for Gnome 3 based distributions, but for Ubuntu there's only one you need to get, the aptly-named Unity Tweak Tool. Install it with `apt-get install unity-tweak-tool` and go wild!

GET GRUBBY

The GRUB boot menu is not a beast to be tamed easily. Sporting a complex configuration file that's auto-updated (meaning, you shouldn't edit it by hand) it can be a hassle making changes or removing old entries. Fear not, for there is always Grub Customizer! Install it like so:

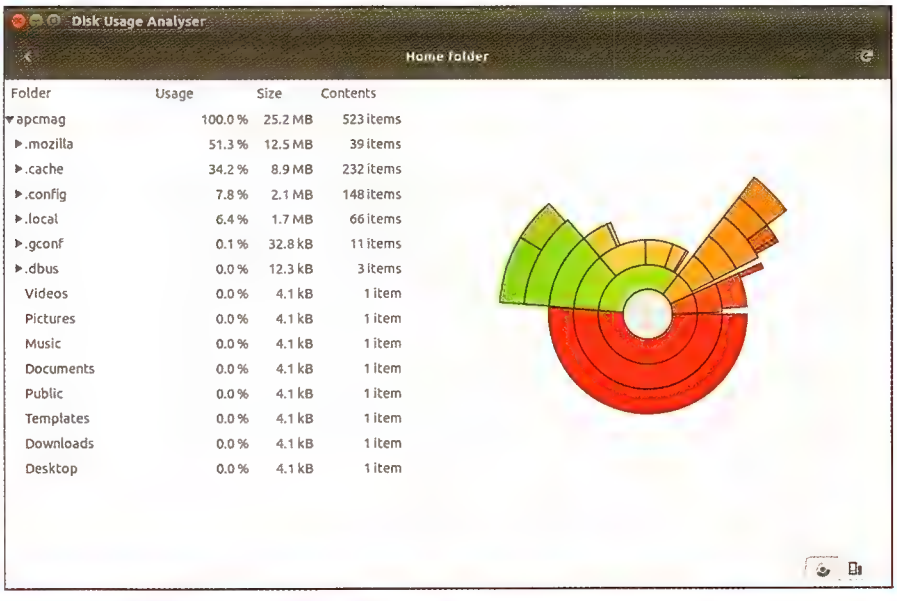
```
sudo add-apt-repository ppa:danielrichter2007/grub-customizer && sudo apt-get update && sudo apt-get install grub-customizer
```

RECOVERING ROOT

Sometimes, it happens – you've managed to forget the root password and you can't update your system or get in to fix it. But there are ways! When you reboot at the GRUB menu – you may need to hold down shift during boot to see it – select the '(recovery mode)' version of your Ubuntu boot from the Advanced Options menu. Then select 'root' from the subsequent menu to drop to a terminal with root access. Now type `passwd` to set a new password for the root account. You can also set a new password for your main user account with `passwd <your username>`.

JUST BECAUSE COWS

Linux is nothing if not... mooo! Hey, calm down Cow, we're getting to you. Many a distribution will bundle the programs *fortune* and, sometimes, *cowsay* (if you don't have them, `apt-get install` them). Combine these as `fortune |cowsay` and add it to the end of your `~/.bashrc` file and you can marvel at a bovine waxing wisdom every time you launch a terminal. Use the '-l' flag on cowsay alone to see its alternative forms which include borg, stoned, koala, hellokitty, tux and more! For more cowage, try running `apt-get moo`.


Disk Usage Analyser
Home Folder
Folder Usage Size Contents
apcmag 100.0 % 25.2 MB 523 items
.mozilla 51.3 % 12.5 MB 39 items
.cache 34.2 % 8.9 MB 232 items
.config 7.8 % 2.1 MB 148 items
.local 6.4 % 1.7 MB 66 items
.gconf 0.1 % 32.8 kB 11 items
.dbus 0.0 % 12.3 kB 3 items
Videos 0.0 % 4.1 kB 1 item
Pictures 0.0 % 4.1 kB 1 item
Music 0.0 % 4.1 kB 1 item
Documents 0.0 % 4.1 kB 1 item
Public 0.0 % 4.1 kB 1 item
Templates 0.0 % 4.1 kB 1 item
Downloads 0.0 % 4.1 kB 1 item
Desktop 0.0 % 4.1 kB 1 item

Android secrets

Unlock the real potential of your Android phone or tablet with these tweaks, tips and techniques. Dan Gardiner

INSTALL A CUSTOM ROM

A custom ROM will radically change your Android device. They're a great way to get a 'pure' Android experience, with the latest OS version, excellent performance and access to tweak and adjust settings to your heart's delight. And installing them has become much easier, thanks to efforts by some of the bigger custom ROM makers like CyanogenMod (**www.cyanogenmod.org**) which has a dedicated Installer app that walks you through the process. The catch: vendors don't want you changing your device so radically, so installing a custom ROM will void your warranty. But if you've got an older device that's feeling sluggish, this is a great way to give it a new lease on life.

REPLACE YOUR LAUNCHER

If installing a custom ROM sounds a bit too risqué for you, the alternative is to switch to a different launcher. Launchers are basically the interface that runs on top of Android – they're the reason different Android phones' front ends look different from each other. You're not stuck with these default launchers, however, and switching to a third-party one can unlock a good deal more customisability, including fitting more apps on a page, changing themes and speeding up the interface as a whole. Check out Nova (**novalauncher.com**), Apex (**apexlauncher.com**) or GO (**tinyurl.com/apc415-go**) to get started.

GET LOCATION AWARE

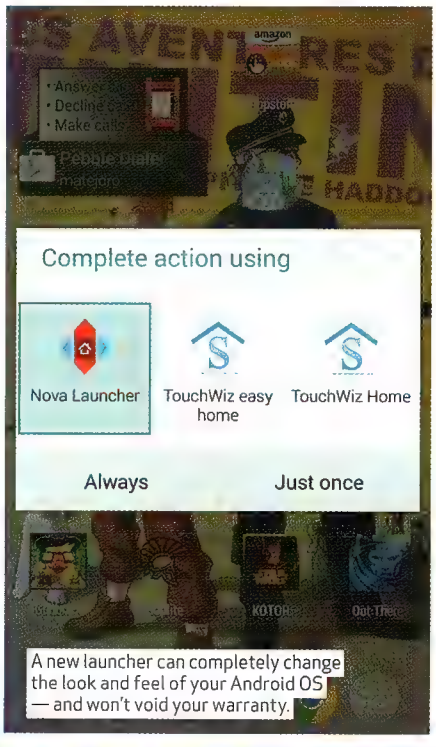
The GPS chips in all our smartphones and tablets are great for getting directions, but they can also be useful for enabling or disabling settings and other elements. There are multiple ways you can create custom, location-based actions (like say, turning Wi-Fi and Bluetooth off when you're away from home), but our favourites are Tasker (it's a paid app, but you can download a trial at **tasker.dinglisch.net**), which is a self-contained tool that's great for adjusting device settings, or the IF by IFTTT app (**ifttt.com**), which can tie into other systems services – including smart home gear like Belkin's Wemo and Philips Hue.

UNLOCK DEVELOPER OPTIONS & ENABLE UNKNOWN SOURCES

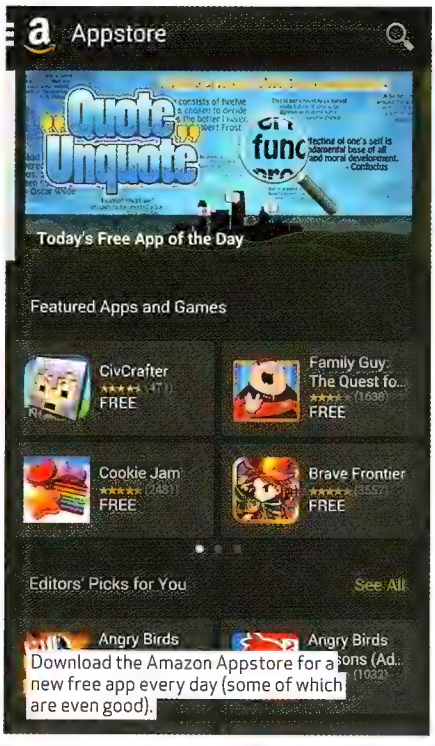
These are both advanced features that are critical if you want to root your phone or flash a custom ROM (in the case of 'Developer Options') or install apps and games from outside the Play Store (so-called 'Unknown Sources'). The latter is key if you want to use the Amazon Appstore, mentioned below. To enable Developer Options, open 'Settings > About phone/device' and then tap the 'Build number' element seven times; Developer Options will then appear under the System or Device area of the Settings app, depending on the device. For Unknown Sources, head to 'Settings > Security' and check the relevant box, after which you'll be able to download and use third-party .apk app installers.

GET APPS AND GAMES FOR FREE

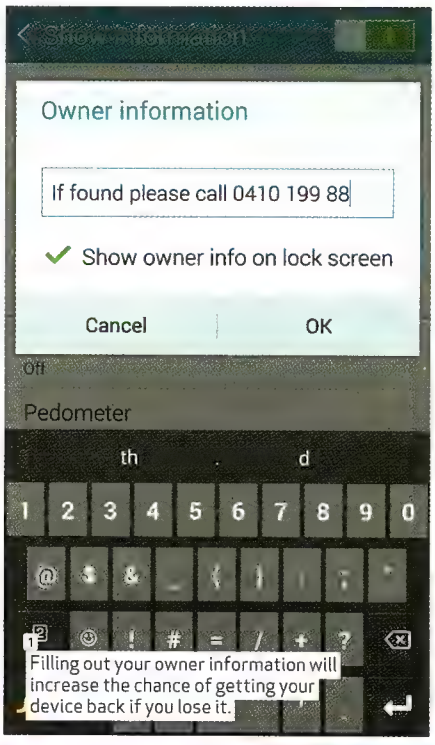
There's a heap of free games and apps for Android, but the vast bulk of those are, frankly, pretty rubbish. For better free apps, start by installing the Amazon Appstore (**www.amazon.com/getappstore**), which offers a free commercial Android app or game every day. You can also head to the XDA forums (**tinyurl.com/apc415-xda**) to grab some of the community-developed tools and utilities there, many of which are also for sale on the Play Store, but are offered free to other XDA community members.



A new launcher can completely change the look and feel of your Android OS – and won't void your warranty.



Download the Amazon Appstore for a new free app every day (some of which are even good).



Filling out your owner information will increase the chance of getting your device back if you lose it.

GET FREE PLAY STORE CREDIT

Google has its own market research app, called Opinion Rewards, that doles out Play Store credit to users for simply completing surveys – it can be used to purchase anything on the Play Store from apps and games to movies, TV and ebooks. Surveys usually consist of 3-5 questions and take a few minutes to complete, with rewards generally varying from $0.10 to $1, depending on survey length.

REPLY TO SMSs ON YOUR PC

If you want to make working across multiple devices a little more frictionless, we're fans of Pushbullet. Install an app on your phone, which then pushes notifications to a PC or Mac app (or Chrome extension), from there you can open links and quickly draft and send replies to emails, SMSs and other messages. A great way of getting your Android and 'real' PC to work in harmony with each other.

ENTER OWNER INFO

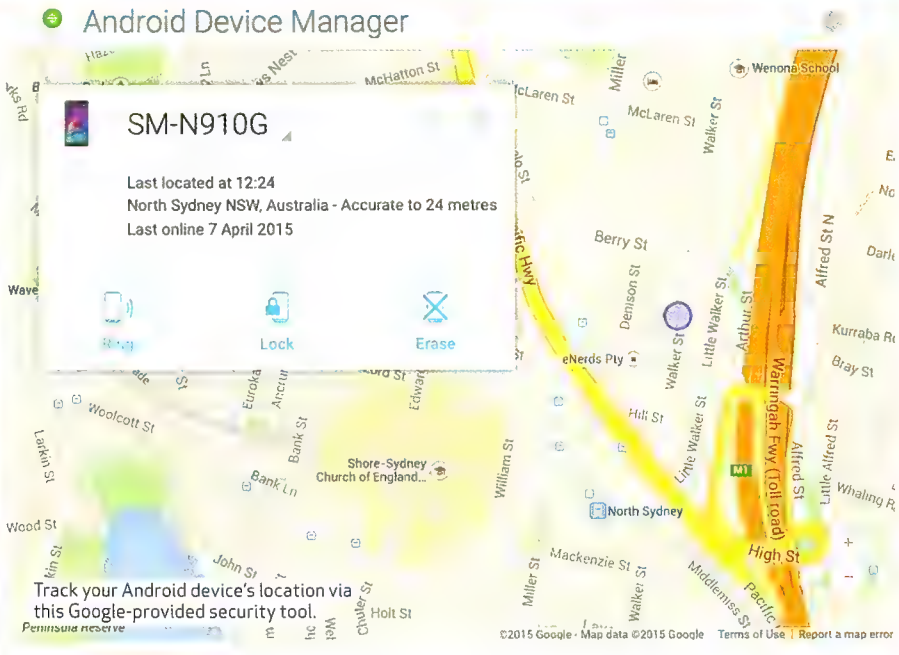
If you lose your phone, this trick could help you get it back more easily – it lets you write a short message that's displayed on your phone or tablet's lock screen. That could be your name and email (or a secondary phone number), for example, the idea being that if someone finds your lost device, they can easily contact you to arrange its return. The 'Owner info' page is hidden away in different areas depending on your phone; on Nexus devices, you can generally find it under 'Settings > Personal > Security > Owner info'. On a newer Galaxy device, look under 'Settings > Device > Lock screen > Show information > Owner information'.

TRACK YOUR PHONE'S LOCATION

Android Device Manager is a Google-made tool designed to be the Android equivalent of Apple's 'Find My iPhone' app – and it's a must-have in our book. Install it on your phone or tablet and, provided its turned on and has a data connection, you can track the device's location just by logging into your Google account in any web browser. There are options to call phones, remotely change your PIN or even wipe a device completely... although doing so will obviously mean you can't track it any more. Get ADM from the Play Store at **goo.gl/qHpG0P**.

SEE WHAT'S DRAINING YOUR BATTERY

While most major apps are fairly good when it comes to power use, the occasional runaway app can sometimes drain the heck out of your battery. To track down the culprits, on Nexus devices open 'Settings > Device > Battery' (on Galaxy phones you can likely find it under 'System > Power saving') and scroll down to below the battery graph to see a list of both system processes and apps/games, sorted by their power use. Your screen should usually be at the top of that list.


Android Device Manager
SM-N910G
Last located at 12:24
North Sydney NSW, Australia - Accurate to 24 metres
Last online 7 April 2015
Ring
Lock
Erase
Track your Android device's location via this Google-provided security tool.
©2015 Google · Map data ©2015 Google
Terms of Use
Report a map error

CUSTOMISE THE QUICK SETTINGS

Pretty much every Android device offers a bunch of what are known as 'Quick Settings' in the notification area – toggles that let you do things like turn Wi-Fi or Bluetooth on and off or adjust brightness and so on. Some phones let you choose what toggles you want, but many frustratingly don't. There's a handful of apps that can get around this, though, by creating a permanent notification with your own custom selection of toggles. Our favourite is Settings Extended, which you can find at **tinyurl.com/apc415-setex**.

BETTER LED NOTIFICATIONS

One of Android's oft-touted benefits over iOS is that many devices have LEDs to alert you of notifications. Most phones don't make full use of their LED's capabilities though – these little lights can display millions of colours, so why not set specific colours for specific apps? That's exactly what apps like Light Manager (**tinyurl.com/apc415-light**) do – letting you select colours and light patterns for notifications on a per-app basis. Make Gmail notifications red with slow blinks, chats green with faster blinks and work emails blue with medium blinks and you'll know exactly what's demanding your attention without having to wake your phone.

CUSTOMISE APP NOTIFICATIONS (LOLLIPOP)

While we're on the topic of notifications, if you're lucky enough to have a phone or tablet with Android 5.0 (aka Lollipop), you'll find you have much finer control over how aggressive apps are with notifications. This includes being able to set priority notifications, which always appear at the top of your list, whether notifications should be shown on your lockscreen, and a new 'silent mode' called Downtime that silences notifications for specific hours. Go to 'Settings > Sound & notification' to set it all up to your liking.

LOCK USERS TO A SINGLE APP (LOLLIPOP)

Don't you hate it when you lend your phone to a friend and they use it to post lewd messages to your Facebook account. (OK, maybe that's just *our* friends...) Android 5.0+ offers a new feature to prevent that, called 'Screen pinning'. To enable it, open 'Settings > Security' and find the 'Screen pinning' toggle and turn it on. Next, to pin an app, open it up, then hit the Overview button (it's the square one on the bottom bar) then tap the 'cork board pin' icon at the bottom right of the app window. You'll be prompted as to whether you want to require a security code/pattern to exit the app. Finally, click Start to pin the app.

USE A GUEST ACCOUNT (LOLLIPOP)

If you want to let someone have slightly more open access to your device, Lollipop lets you quickly log into your device as a guest user, so none of your account or app settings are messed with. To switch to a guest account, pull open the notifications pane, tap the user icon once and then tap it again. Tap Guest and you'll immediately be switched to a temporary account that you can safely let anyone else use. If desired, you can also create permanent additional users by tapping the 'Add user' button.

iOS secrets

The APC team rounds up their favourite tricks and techniques for iPhone and iPad.

TOGGLE PREDICTIVE TEXT ON AND OFF EASILY

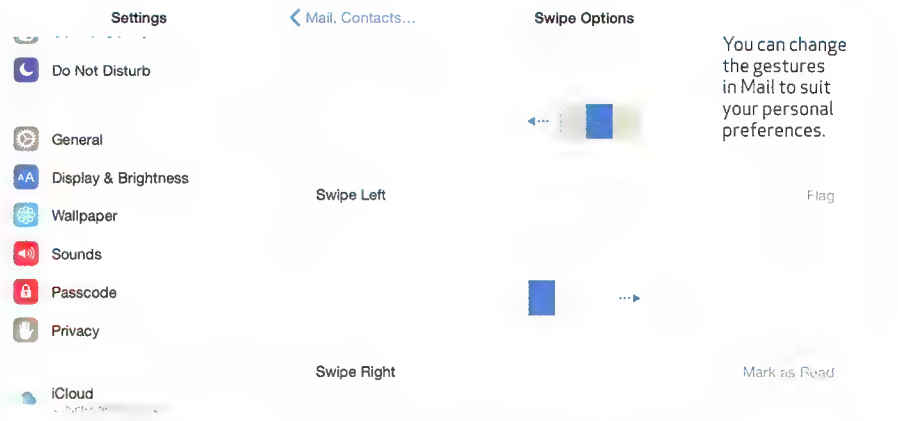
One of iOS 8's biggest areas of improvement is in the keyboard, with headline features such as QuickType and the ability to add third-party keyboards so you can enter text in different ways. (There's even one called PopKey coming that lets you quickly 'type' with meme GIFs!) But here's a hugely handy little extra tip. If you tap and hold on the keyboard switcher icon, you'll see a toggle switch at the top which can quickly switch between using iOS's autocorrect feature and disabling it – useful if in the middle of a message you want to type in some jargon or some silly words with friends without autocorrect stepping in.

REQUEST DESKTOP SITE IN SAFARI

Safari now lets you request the desktop version of a web site you visit. If you'd rather view the full desktop version of a site, tap the Search field and drag down to reveal Request Desktop Site. This new option will reload the page in Safari as the standard desktop site, which may offer more features than the mobile version.

CUSTOMISE MAIL'S NEW SWIPE OPTIONS

Mail has enhanced swipe gestures for quickly dealing with messages by swiping left or right on them. You can customise these options via 'Settings > Mail, Contacts, Calendars > Swipe Options'. You can choose from None, Mark as Read, Flag, and Archive. For Swipe Left, your choice appears in the list of shortcuts that swiping partway reveals, but swiping all the way always deletes a message.



RICH TEXT EDITING IN NOTES

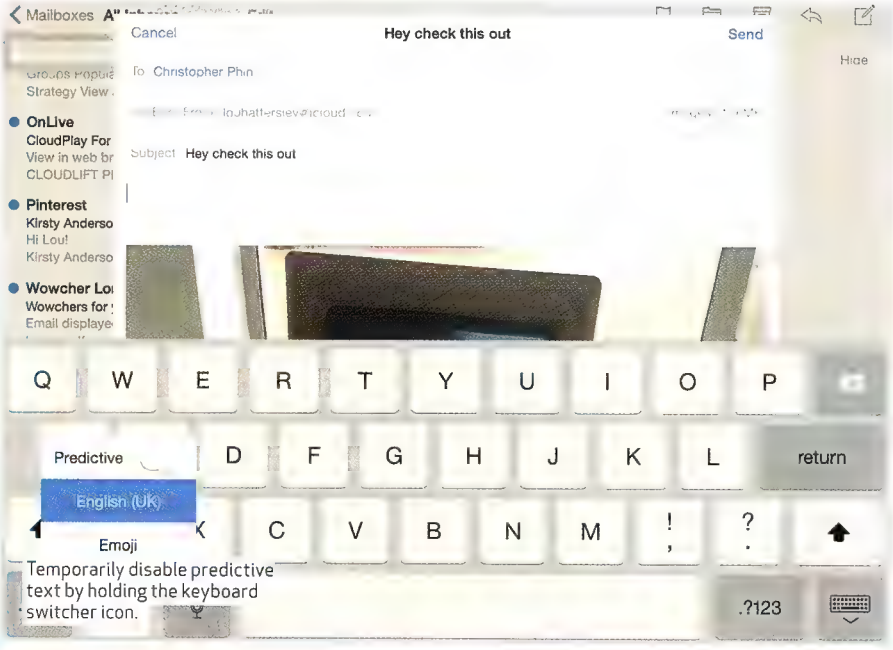
Notes now sports rich text editing functionality so you can create more elaborate notes. Tap and hold on text to reveal the menu, and tap More and the 'BUI' formatting icon. This reveals the Bold, Underline and Italics options that you can use to stylise your text. These are the only options available so far (we would like bulleted and numbered lists too) but they're a useful improvement over standard plain text.

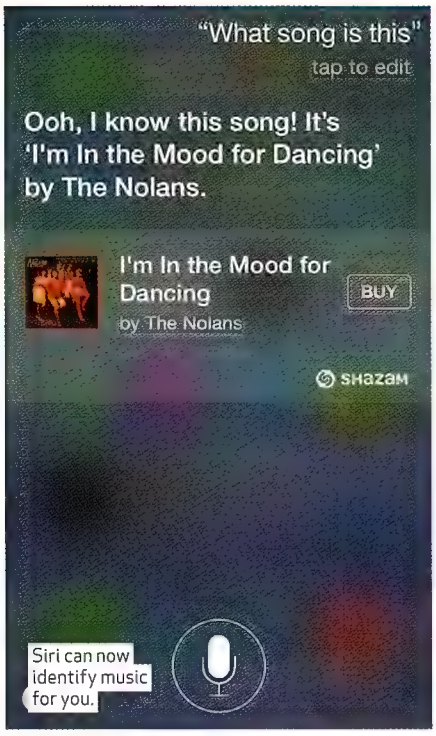
BATTERY USAGE BY APP

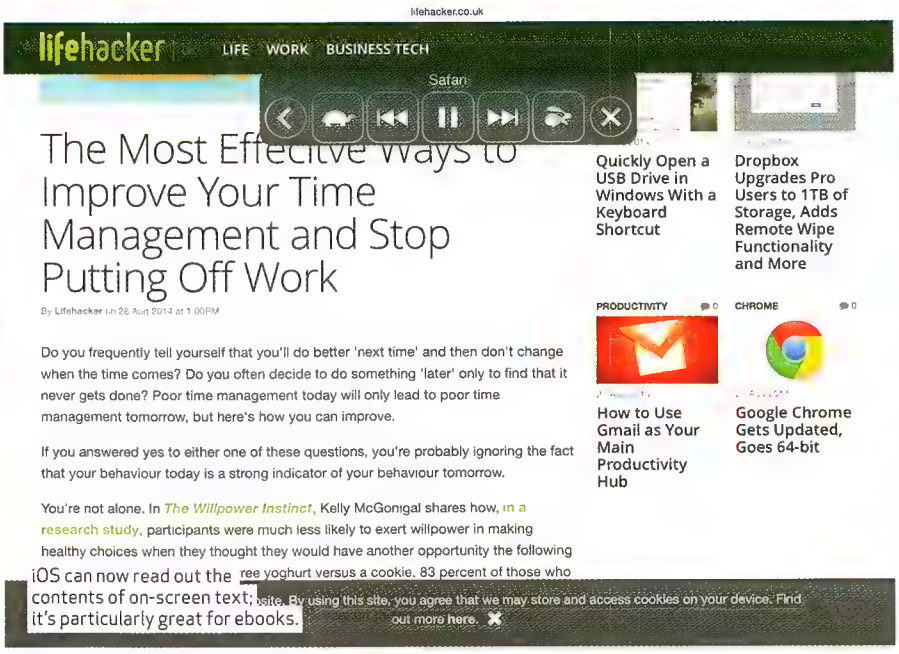
The new Battery Usage feature enables you to identify, and potentially remove, apps that are taking too much battery life. Click 'Settings > General > Usage > Battery Usage' to view the stats. You can view Battery Usage data by Last 24 Hours or Last 7 Days using the two tabs. The figures in the Battery Usage feature show the percentage of your battery that is used by each app when your iOS device isn't charging.

DUCKDUCKGO SEARCH ENGINE

Privacy advocates will be overjoyed to hear that DuckDuckGo is now available




"What song is this"
tap to edit
Ooh, I know this song! It's 'I'm In the Mood for Dancing' by The Nolans.
I'm In the Mood for Dancing
by The Nolans
BUY
shazam
Siri can now identify music for you.


lifehacker.co.uk
lifehacker
LIFE WORK BUSINESS TECH
Safari
The Most Effective Ways to Improve Your Time Management and Stop Putting Off Work
By Lifehacker on 26 Aug 2014 at 1:00PM
Do you frequently tell yourself that you'll do better 'next time' and then don't change when the time comes? Do you often decide to do something 'later' only to find that it never gets done? Poor time management today will only lead to poor time management tomorrow, but here's how you can improve.
If you answered yes to either one of these questions, you're probably ignoring the fact that your behaviour today is a strong indicator of your behaviour tomorrow.
You're not alone. In The Willpower Instinct, Kelly McGonigal shares how, in a research study, participants were much less likely to exert willpower in making healthy choices when they thought they would have another opportunity the following
Quickly Open a USB Drive in Windows With a Keyboard Shortcut
Dropbox Upgrades Pro Users to 1TB of Storage, Adds Remote Wipe Functionality and More
PRODUCTIVITY
How to Use Gmail as Your Main Productivity Hub
CHROME
Google Chrome Gets Updated, Goes 64-bit
iOS can now read out the contents of on-screen text; it's particularly great for ebooks.
ree yoghurt versus a cookie. 83 percent of those who
osite. By using this site, you agree that we may store and access cookies on your device. Find out more here.

as a default search engine option in Safari. DuckDuckGo has a big emphasis on keeping its users' privacy intact. Tap 'Settings > Safari > Search Engine > DuckDuckGo'. Now when you tap the Search field in Safari it will return results from DuckDuckGo and not Google.

SEARCH KEYBOARD SHORTCUTS

Power users of the iOS keyboard shortcuts feature will appreciate the new search and index function. Tap 'Settings > General > Keyboard > Shortcuts' to view the new features. Use the Search bar at the top to search for both the Phrase and Shortcut. On the right is an A-Z index for you to browse large shortcut lists.

TAG MUSIC WITH SIRI

Siri now supports Shazam and can identify music that is playing. Just activate Siri and say "what song is this?" Siri also provides links to the iTunes Store so you can buy the track. Music tagged by Siri also appears in the iTunes Store app: tap the Menu item in the top-right and choose the Siri tab to view all the music you've tagged in Siri.

SHARED REMINDER LISTS

One absolutely welcome feature is the ability to create shared lists in Reminders right from iOS, so multiple people can add items to the list. Open the Reminders app and tap on the list; now tap on the Edit button and choose 'Sharing > Add Person' and enter the name of the person, and tap Add. They will get an email message asking them if they want to join the shared Reminder list. Items can now be added and completed by both people.

ENABLE GRAYSCALE MODE

A fascinating new option in Accessibility enables you to view your iPhone in black and white. If you fancy using your iPhone without any colour (or find that it's easier to read the screen in monochrome), click 'Settings > General > Accessibility' and set the Grayscale option to On.

DO NOT DISTURB

It's now possible to mute individual conversations in Messages with a new Do Not Disturb feature. Tap on Messages and pick a conversation from the list. Now tap on Details and set Do Not Disturb to On. You will no longer get any messages from that conversation until you reset Do Not Disturb to Off. Note that it doesn't turn off by itself, so if you forget about it you'll get no messages at all. Also it only works on that device, so you will still get messages on your other devices (the feature can also be found in OS X 10.10 Yosemite so you can mute conversations on your iPhone, iPad and Mac).

SPEAK THE SCREEN

One essential new feature in Accessibility is called Speak Screen. With Speak Screen activated you swipe two fingers down the screen to speak the contents of any app. In Safari, you can get a vocal reading of a web page. To activate it, go to 'Settings > General > Accessibility > Speech' and set Speak Screen to On. Open Safari, navigate to a web page and pull two fingers from the top of the screen.

READ OUT IBOOKS AND KINDLE BOOKS

The Speak Screen option is also outstanding when used in conjunction with iBooks or the Kindle app. Activate the Speak Screen options in accessibility and open a book in iBooks or Kindle. Now pull two fingers down and iOS 8 will start to read the book out loud. It will turn pages automatically and will even read out the whole book if you want it to. You can use the hare and tortoise icons to speed up or slow down the reading speed.

NEW TIPS APP

There is a new app called Tips in the Extras folder. Open it to find a bunch of new tips for iOS 8, and tap on the Menu item in the bottom left to view all the tips. These are updated on a weekly basis so you can keep checking back with the app. You can't delete the Tips app, and it will send notifications to you. If you find these annoying, you can turn them off by visiting 'Settings > Notifications > Tips', and setting Allow Notifications to Off.

For more iOS 8 tips, check out Apple's dedicated Tips app.

Battery secrets

Get your battery-powered tech lasting longer

Darren Yates reveals his latest and best tricks

Improve your notebook's battery life by swapping the hard drive for an SSD.

HAVE AN OLED? USE NIGHT MODE

If your mobile device has an OLED panel, you can reduce power consumption by using 'night mode' where available on compatible apps such as book readers like Aldiko on Google Play (**tinyurl.com/pkyzs4w**). OLEDs don't have backlighting – each set of sub-pixel LEDs generate their own light. That means white text on a black background will draw less power than black text on a white background, since black requires little-to-no power – and that should improve overall battery life. Combine it with setting screen brightness to minimum (not auto) and you'll keep the OLED at its lowest possible power consumption, which should improve battery life further.

SWITCH TO AN SSD

Solid-state drives (SSDs) not only offer a speed benefit over their hard drive cousins, there's an additional pay-off in reduced power consumption as well. A typical 2.5-inch notebook hard drive will consume roughly six watts (6W) of power in operation. By comparison, an SSD typically comes in around the two-watt (2W) mark. So not only will you get the benefit of faster read and write speeds, you should also gain some extra battery life. Consider the best option for your budget, but by design a 240GB SSD should last twice as long as a 120GB SSD at equal usage, simply because there are twice as many flash storages cells available.

DON'T LET THE BATTERY GO FLAT

Devices with built-in batteries can be difficult (and expensive) to repair, so to maximise their useful life, play nice with them. Research shows that lithium-ion batteries prefer being discharged to only 50% rather than all the way to zero – keep above 50% and you'll get more hours overall than regularly full-discharging.

USE AIRPLANE MODE

Any radio-transmission feature on your battery device – GPS, Wi-Fi, data network – will suck the life out of the battery. Using airplane mode is a simple way of reducing power consumption, but maintaining the current settings. Turn it back on and those features go back to the way they were. Easy.

MINIMISE SCREEN BRIGHTNESS

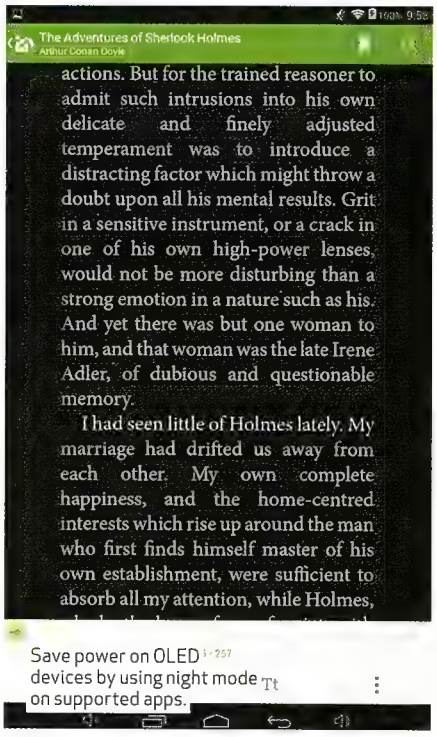
This is an old chestnut – but it's still rings true. The two most power-hungry components in any mobile device are the CPU and the screen panel backlight. Dropping that backlight level to minimum will improve battery life over keeping it on 'auto-brightness'. This might cause problems in bright sunlight, but should be fine indoors.

FASTEST CHARGING MODE

Your mobile device will always charge fastest from its supplied AC power adapter. But if you need an alternative, a USB port is better than nothing. If you can, seek out a USB 3.0 port – they should charge faster than most USB 2.0 ports. Not all third-party USB chargers will match the supplied adapter, so look after that supplied one!

REMOVE EXTERNAL DEVICES

Just because you've shut down your notebook doesn't mean your USB devices switch off as well. I use a USB DVB-T TV tuner, but forgetting to remove it one night, the battery was dead-flat a day later. Top tip: assume any USB device is dragging power from the battery – wheather it's booted or not.


The Adventures of Sherlock Holmes
Arthur Conan Doyle
actions. But for the trained reasoner to admit such intrusions into his own delicate and finely adjusted temperament was to introduce a distracting factor which might throw a doubt upon all his mental results. Grit in a sensitive instrument, or a crack in one of his own high-power lenses, would not be more disturbing than a strong emotion in a nature such as his. And yet there was but one woman to him, and that woman was the late Irene Adler, of dubious and questionable memory.
I had seen little of Holmes lately. My marriage had drifted us away from each other. My own complete happiness, and the home-centred interests which rise up around the man who first finds himself master of his own establishment, were sufficient to absorb all my attention, while Holmes,

Save power on OLED devices by using night mode on supported apps.

DON'T SKIMP ON RAM

Having too little RAM in your notebook will drain the battery – the OS will constantly be paging out data to the hard drive, ensuring it's on all the time and consuming power. Adding more RAM reduces the paging demands, provides the HDD more sleep time, which reduces power consumption. For most users, 8-12GB should be enough.

DC 10.8V 4400mAh/48Wh
Replace: PA3533U-1BRS
CAUTION
Do not dispose of in fire, but keep the battery away from fire.
Do not directly connect (short circuit) the positive (+) and the negative (-) terminals. Never attempt to disassemble or reassemble the battery pack. Do not use chargers other than the designated one to charge this battery pack.
VORSICHT
Den Akkusatz vor Hitze und Feuer schützen; nie in ein Feuer werfen. Die positiven (+) und negativen (-) Anschlüsse nie direkt miteinander verbinden (Kurzschluß). Nie versuchen, den Akkusatz auseinanderzunehmen oder baulich zu verändern. Für diese Batterie sind nur die dafür vorgesehenen Batterieladegeräte zu verwenden.
Li-ion

Keep at least 50% capacity in your battery to get maximum hours from it.

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The Billion brand has been providing customers in Australia with quality and affordable networking products for over 12 years. We also define our user-friendly product packages by integrating with new technologies such as wireless, powerline, and VoIP into our product family to enable our customers to enjoy the beauty of compact design without purchasing extra hardware.

With the launch of the popular dual-wireless "V series in 2012, followed by the fibre ready triple-WAN "7800 series" in 2013 and the rcent wireless AC 8800AXL, Billion continues to offer feature loaded, affordable products, that won't let you down.

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Billion Electric Co., Ltd. (Taiex: # 3027, since 1973, is one of the leading providers of network equipment in the Asia Pacific region.
For more information, please visit billion.com.au. Billion is exclusively distributed by PC Range Pty Ltd. pcrange.com.au

BILLION®

Home networking secrets

Want to make the most of your home network? Try these tips from Nathan Taylor.

Wireless

RANGE EXTENDERS ARE NOT ALL THAT GREAT

If you're having reception issues, a range extender might seem like an easy option. But in terms of performance they kind of suck, adding significant latency and reducing bandwidth. A better bet is to buy a second wireless access point and link it to the first one via an Ethernet cable or powerline HomePlug adapter.

VERTICAL RECEPTION IS OFTEN A PROBLEM

Most router antennae are aligned for best reception on the horizontal plane, which is often a problem in multi-storey homes. Don't place your router in the basement or attic/roof; instead put it near the floor on the upper level (the best option, since they generally have better downward reception than upward), or near the ceiling on the lower level. If that doesn't work, you may have to simply get another access point for each floor, and link them together with Ethernet cables or HomePlug.

802.11N STILL HAS A PLACE

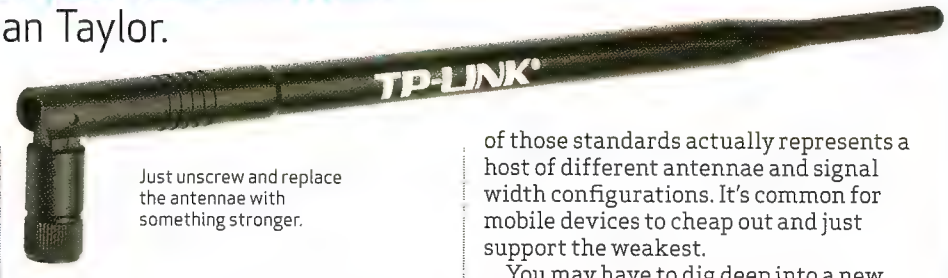
The higher the frequency, the harder it is for a wireless signal to travel through walls and intervening objects. 802.11ac, the newer wireless standard, only operates at 5GHz, while 802.11n operates at 2.4GHz or 5GHz. Although it's a lot slower, you may find it worthwhile to keep at 2.4GHz network active since it may reach the distant corners of your home better.

MAKE YOUR OWN PARABOLIC ANTENNAE

Another cheap way to extend your range is to make your own parabolic directional antennae. You just need some tinfoil and a printer, then you can follow the instructions at **www.freeantennas.com**. This focuses your wireless signals in a certain direction, which is useful if your router is placed at the edge of your home (which is very often the case). Of course, wireless signals in the other directions suffer.

OR YOU CAN GET A COMMERCIAL HIGH-GAIN OMNIDIRECTIONAL ANTENNA

Various companies make high-gain antennae that you can replace your router's regular antennae with



Just unscrew and replace the antennae with something stronger.

(assuming your router has external detachable antennae). 8dBi and 12dBi antennas should give a significant boost to your router's default signal (most antennae are in the 2-5dBi range).

OPEN FIRMWARE LIKE DD-WRT GIVES YOU MORE POWER OVER YOUR WIRELESS SETTINGS

If you're willing to go through the process of installing third-party firmware on your router you can tweak a lot of settings that you don't have access to in normal factory firmware. Most notably, you can increase the transmit power of the router, which might help it push through to normally dark parts of your home. Don't increase it too much, however – it can fry your router if you push it too far.

CHECK YOUR MOBILE SPECS

There isn't just one 802.11n and one 802.11ac standard configuration. Each of those standards actually represents a host of different antennae and signal width configurations. It's common for mobile devices to cheap out and just support the weakest.

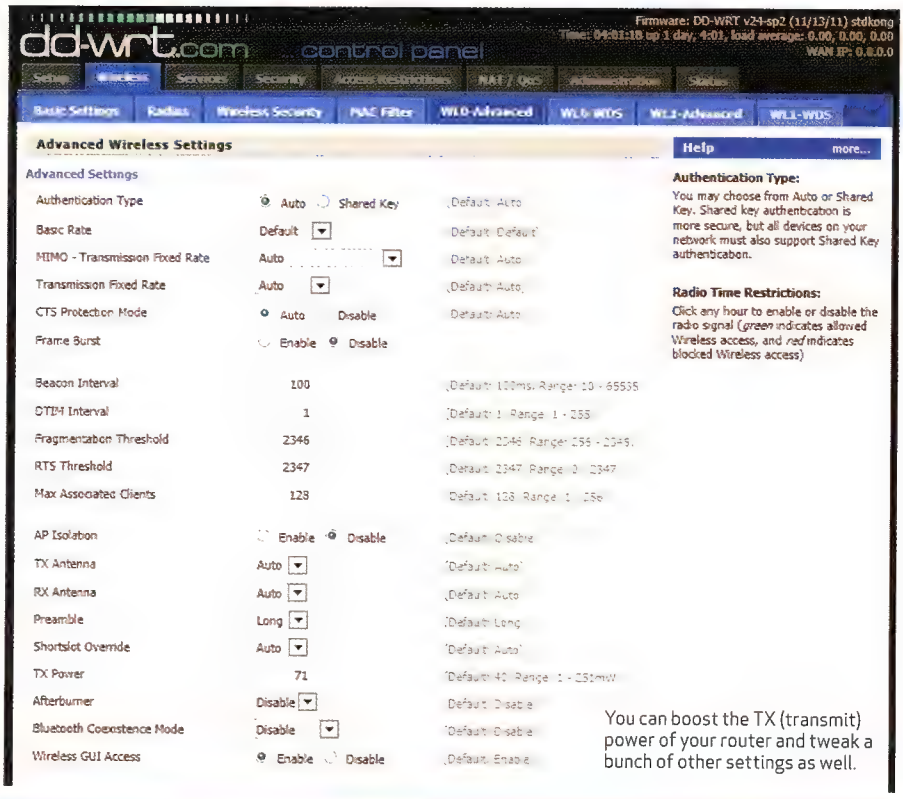
You may have to dig deep into a new mobile's specs to find its wireless support details, but look for 802.11ac support, MIMO and 80MHz channel support in a new mobile device.

TURN A PC INTO A WIRELESS HOTSPOT

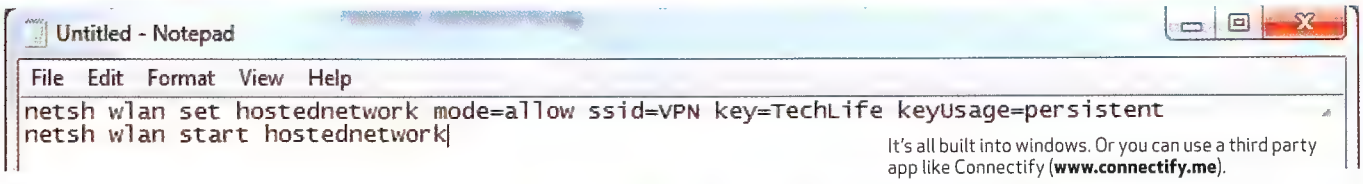
If your Windows PC has an unused Wi-Fi adapter, you can turn it into a Wi-Fi access point with a couple of simple lines in Windows. Open Notepad and type in these two lines, replacing <SSID> and <Password> with the network name and password you want.

```
  netsh wlan set hostednetwork
mode=allow ssid=<SSID>
key=<Password>
keyUsage=persistent
  netsh wlan start
hostednetwork
```

Save the file, but not as a text (.txt) file – change the extension to .bat. Then right click on the batch file you've just created and run as administrator. Your



You can boost the TX (transmit) power of your router and tweak a bunch of other settings as well.


Untitled - Notepad
File Edit Format View Help
netsh wlan set hostednetwork mode=allow ssid=VPN key=TechLife keyUsage=persistent
netsh wlan start hostednetwork

It's all built into windows. Or you can use a third party app like Connectify (**www.connectify.me**).

PC will now be a wireless hotspot that other users and devices can connect to. You can even share things like 3G modems by right clicking on the modem/network connection in the Network adapter control panel and enabling Internet Connection Sharing.

Wired

NOT ALL ETHERNET CABLES ARE CREATED EQUALLY

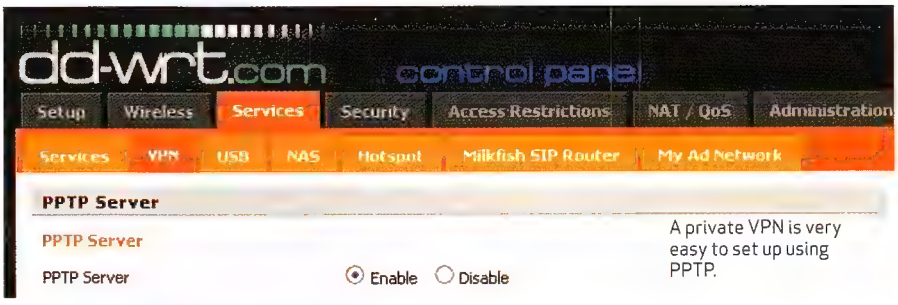
If you're running permanent Ethernet cable between points in your home, make sure that the cable is Cat 6a (not Cat 5e or 6), which future proofs it for future network speed upgrades. For running through wall ducts and in bundles, also look for shielded/foiled twisted pair (S/FTP).

DON'T GET CHEAPED ON POWERLINE ADAPTERS

A new generation of HomePlug powerline adapters is coming out, and they're vastly superior to the existing 500/600Mbps models. Look for 1Gbps+ powerline adapters.

DIRECT WALL PLUGS ARE THE GO WITH HOMEPLUG

When using HomePlug, avoid powerboards and extension cables if you can. They can put a big dent in your powerline network performance and often cause the powerline adapter to lose its connection. Directly plugging them into wall sockets is best.



A private VPN is very easy to set up using PPTP.

YOU CAN DAISY-CHAIN ETHERNET SWITCHES

Given the magazine you're currently reading, it's a good bet you're something of a super-nerd, meaning you have a whole bunch of devices in your loungeroom that need hooking up to your network. Rather than run a cable from each of them all the way back to your router, put a switch in your loungeroom and run a single cable back to your router.

Even better, put a second router/access point in your loungeroom, and use it as your wireless access point and loungeroom switch, since in most cases it will be more centrally located than your router.

And if you want to get really funky, get a router and install DD-WRT on it. Then configure it as a wireless client bridge (where it acts as a bridge to your main router) and chuck away the cable that links it back to your main router. Any data that comes into its Ethernet ports wills be transmitted over the wireless network back to your main router at high speeds.

The D-Link DHP-701AV offers up to 2Gbps over power lines.

VPNs and software

SHARE YOUR VPN

If you have a VPN service that you'd like to share with all of your devices (including mobiles, consoles and other devices), you can. Set up the VPN on your PC, then set your PC up as a wireless access point.

Then go into your network adapter settings (from the Network control panel) and right click on the VPN adapter and select settings, then use Internet Connection Sharing to share the VPN. Then, any device that connects to your PC's wireless access point will use the VPN for internet connectivity.

OPEN FIRMWARE IS AWESOME FOR VPNS

An alternative is to use your router to connect to the VPN, so that all traffic is routed through the VPN. To do this, you'll need router firmware that supports VPNs – and most do not out of the box. You can install DD-WRT (**dd-wrt.com**), Tomato (**www.polarcloud.com/tomato**) or an OpenWrt (**openwrt.org**) build, however, to get it. This firmware has VPN client capabilities built in, and your VPN provider should have a guide on how to set them up.

The open firmwares also have an extra VPN capability – they can also be a VPN server, allowing you to "dial home" from your mobile, keeping you secure at public Wi-Fi hotspot and letting you access things like your NAS server from anywhere.

SAVE MAJOR 3G BANDWIDTH WITH GOOGLE'S DATA SAVER

If you use a 3G internet connection (or other tightly limited connection), a new Chrome add on from Google called Data Saver pre-compresses web site data before it gets to your mobile or PC. It's definitely worth installing – we've seen data reduction typically in the 30-40% range.

Download secrets

So you'd like to get the most out of your media downloads while staying safe from prying eyes. Here's some of Nathan Taylor's favourite tricks for doing just that.

USE A VPN TO REMAIN ANONYMOUS

A VPN service is useful for more than just passing geo-blocks. If you're worried about your online activities being tracked, a VPN will keep you anonymous when you're downloading.

CHANGE YOUR NETFLIX LOCATION FOR MORE STUFF

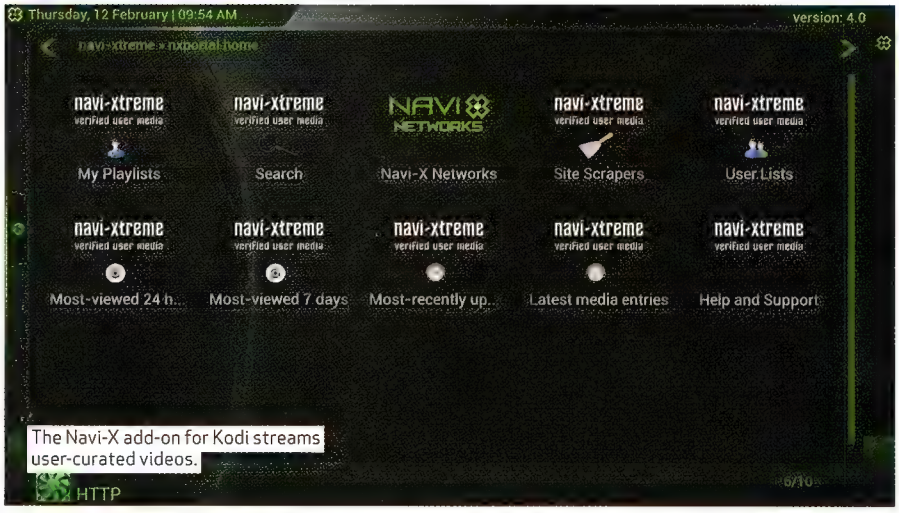
Compared to the US, the content on Netflix Australia is a little anaemic. The thing is, one Netflix account is good for all regions, and you can get more content just by switching locations.

There are a number of ways to change your Netflix location. One is to use a VPN service, but perhaps an easier and cheaper way is to use a smart DNS service like Getflix (**getflix.com.au**), Unblock US (**www.unblock-us.com**) or UnoTelly (**unotelly.com**). They're much easier to set up on non-PC devices than VPNs (all you need to do is change the DNS number).

IT'S MORE THAN JUST THE US

Whether you use a smart DNS service or a VPN to bypass geo-blockers, remember it's not just about the US. Try different countries to see what options are available in each location. For example, Netflix might have a content deal for a show in the UK, Canada, Mexico or Denmark that it doesn't have in the US because some other provider in the US has it. Jump around and see what you get.

You can even go backwards – full season AFL streaming (**watchafl.afl.com.au**), for example, is not available normally to Australian viewers because of a deal with Foxtel – but you can set your location elsewhere and subscribe.



The Navi-X add-on for Kodi streams user-curated videos.

IT'S TRIVIALLY EASY TO BYPASS SITE BLOCKS

The Australian government recently required ISPs to start blocking certain sites, and you can be sure that popular BitTorrent sites will be among the first blocked. These site blocks will be very easy to bypass, however.

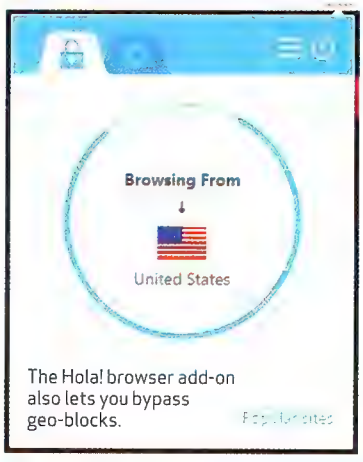
If the ISP uses DNS-based blocking, you can simply configure your PC to use a third-party DNS server like OpenDNS (**opendns.com**) or Google Public DNS (set your DNS to 8.8.8.8 and 8.8.4.4).

If the ISP implements IP address blocking you can:

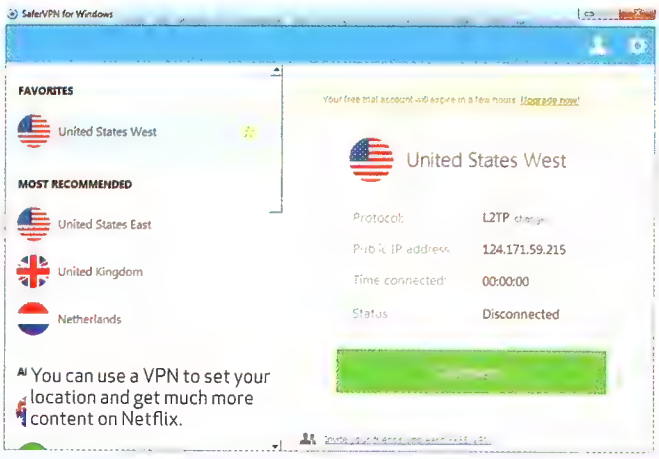
- Use a VPN service.
- Use a free web proxy like Hide Me (**hide.me/en/proxy**), webproxy (**www.webproxy.net**) or webproxy USA (**webproxy.to**). There are even browser add ons, like Hide My Ass! Web Proxy, that allows you to proxy a site just by clicking a browser button.
- Use a browser VPN like Hola! (**hola.org**) which can route all your browsing through a VPN.

SCREENCASTING IS BUILT INTO MORE STUFF THAN YOU THINK

The ability to beam your mobile's screen to a TV set is pretty awesome, and a great way to view downloaded or streamed content without hassle. What you may not know is that you can also cast your PC's screen to the TV. Miracast is built into Windows 8.1 – just go to Devices and add a new wireless display.

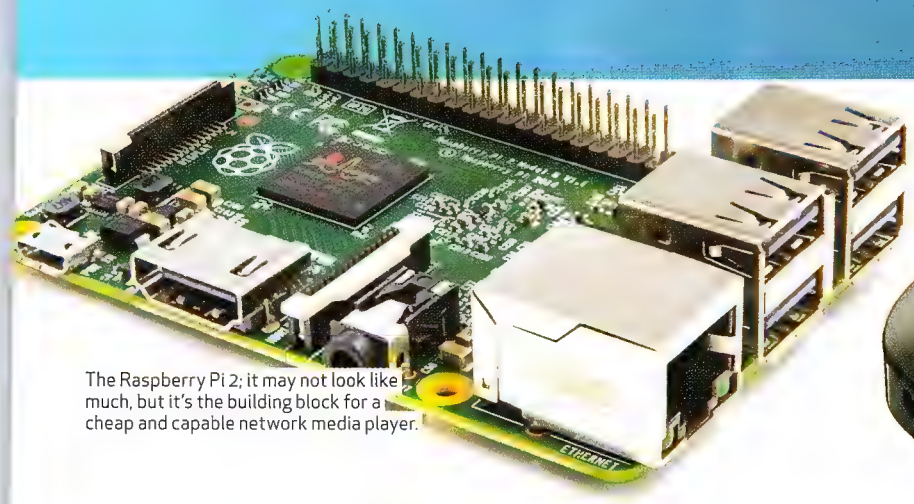


The Hola! browser add-on also lets you bypass geo-blocks.



You can use a VPN to set your location and get much more content on Netflix.

µTorrent Remote lets you kick off downloads from your mobile, wherever you may be.



The Raspberry Pi 2; it may not look like much, but it's the building block for a cheap and capable network media player.

Support for Chromecast beaming is becoming more widespread.

You may not even need a dedicated Miracast adapter, either (though the Netgear PTV3000 and Microsoft Wireless Display Adapter are pretty cheap). Miracast can be found in a lot of network media players, including those that support Android (through third party apps like MirrorOp Receiver) and the WD TV.

CHROMECAST ANY VIDEO

Another type of screencasting, Google Chromecast, lets you stream the contents of a browser tab to your TV set. That's great for things like YouTube, but you can also use it to stream local content. In Chrome, press 'Ctrl-O' and choose a local video file, which will then play in the browser tab. It works for MP4 video, but not AVI. If the format is not supported, you can grab the Videocast add-on for Chrome instead. Even better, VLC 3.0 (**www.videolan.org**) is slated to support Chromecast natively.

ALLCAST IS ANOTHER GREAT WAY TO STREAM FROM YOUR MOBILE

Allcast (**www.allcast.io**) for Android and iOS is another handy way to beam content from your mobile. It can stream to a DLNA player, Apple TV or Chromecast.

LIMIT BITTORRENT BANDWIDTH USAGE BY SETTING A SEEDING TARGET

Since most ISPs count uploads as part of your quota, it's a good idea for most Australian and New Zealand users to limit their uploads. Leaving a finished Torrent seeding can be a big blow to your bandwidth. In µTorrent, go to 'Preferences >Queuing' and set a seeding goal of, say, 50% and check the box to limit upload rate (leaving the field at 0).

GO BACK TO AN OLD VERSION OF TORRENT TO AVOID ADS

Ever since it was bought out by BitTorrent inc., µTorrent has been loaded with more and more ads and unwanted add-ons. If that's driving you up the wall, you can always go back to an old version of µTorrent. The BitTorrent protocol hasn't changed, and your downloads will be just as fast. 2.2.1 is the last "clean" version, and can be found at www.filehorse.com/download-µTorrent/7858. Or you could just pay for µTorrent Pro. It's not that expensive.

HAVE YOUR DOWNLOADS READY WHEN YOU GET HOME

There has been some good stuff introduced into µTorrent since version 3.0. The best is probably µTorrent Remote, a service and mobile app that lets you control µTorrent from a mobile. Go to 'Preferences > Remote' and enable it. Set up some RSS feeds in µTorrent from your favourite BitTorrent sites (right click on Feed and paste in a BitTorrent RSS feed URL). Then install the mobile app.

USENET LIVES ON

Another way to get anonymous downloads is to use a Premium Usenet Service and an NZB downloader like SABnzbd+. It's similar to (though a little more complex) than downloading with BitTorrent. Usenet remains unlogged by most premium providers (so there's no record of your downloads), and there are no uploads to suck up your quota.

AUTOMATE YOUR TV AND MOVIE DOWNLOADS

If you do use Usenet, there are several apps that will automatically download TV series and selected movies for you. Check out Sick Beard for TV (**sickbeard.com**) and Couch Potato for movies (**couchpota.to**).

EXPLORE HIDDEN KODI/XBMC ADD-ONS

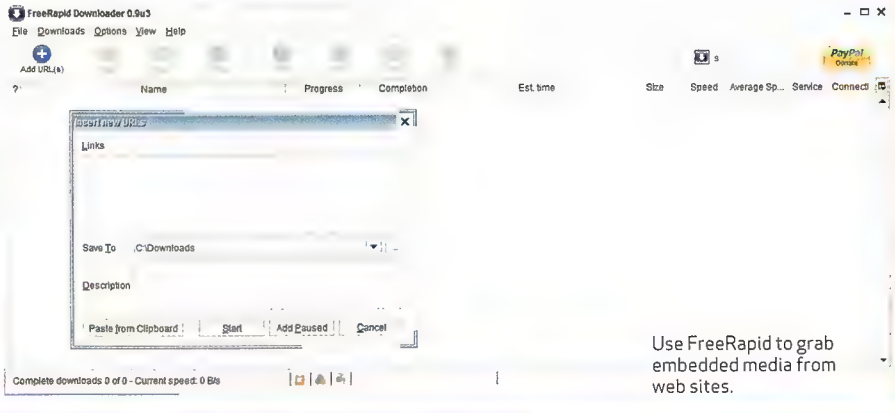
Some of the very best add-ons for Kodi (formerly known as XBMC) can only be found if you install unofficial add-on repositories. Check out SuperRepo (**superrepo.org**) or the Kodi Wiki (**kodi.wiki/view/Unofficial_add-on_repositories**) for some of these unofficial add-ons. In particular, try out Navi-X, Icefilms, 1Channel and Genesis to see how you can turn your Kodi install into a content delivery platform.

YOU CAN MAKE YOUR OWN POWERFUL NETWORK MEDIA PLAYER FOR CHEAP NOW

For $60, you can get a Raspberry Pi 2, an SDCard and case. That's enough to make your own media centre PC. Check out online stores like **www.raspberryworx.com.au**, or **www.buyraspberrypi.com.au**, which will even sell the Pi with software pre-installed. We currently like OSMC (**osmc.tv**) for the OS, which is a custom build of Linux with Kodi installed.

GRAB YOUTUBE VIDEOS, GROOVESHARK SONGS AND MORE WITH FREERAPID

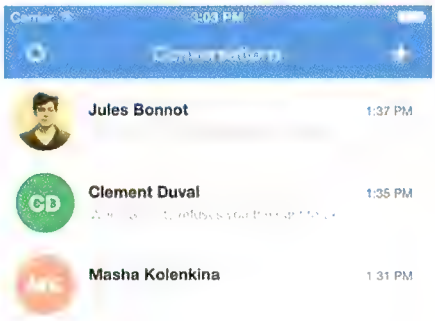
FreeRapid (**wordrider.net/freerapid/**) is a download manager that lets you grab embedded media from a host of media sharing sites. Just paste the content web site address into it and it will grab the video, song or other content and save it to your PC.



Use FreeRapid to grab embedded media from web sites.

Security secrets

You've installed a security suite with antivirus app and a password manager and think you're done with security? You're not even close, says Nathan Taylor.



Signal for iOS, a voice and texting apps that uses the same protocol (and can communicate with) Android phones running RedPhone and TextSecure.

There are a million things you need to look after when it comes to security, and a security suite is just the beginning. Here are our top tips for things to keep you secure:

USE A VPN

Yep, you've probably heard this one a lot, so we won't labour the point here, except to remind you that when it comes to privacy (as well as passing geo-blockers), VPNs are good for what ails ya. Even your ISP won't be able to tell what you're doing online.

WIRELESS HOTSPOTS ARE DANGEROUS. ENCRYPT YOUR DATA

One of the things about public Wi-Fi hotspots is that they're a great place for hackers to work. Anybody on the same public Wi-Fi network as you can technically listen in on the data you're broadcasting to the Wi-Fi access point.

The way to stop this is to encrypt all your data before it's sent by using a VPN. Not only will a VPN service foil geo-blocking and activity monitoring, it will also stop eavesdroppers.

ENCRYPT YOUR TEXTS AND YOUR MOBILE VOICE CHATS END-TO-END

If you don't want anyone, even the government, snooping on your mobile communications, there are apps that provide end-to-end encryption with no middle man. On Android, grab Jitsi (video), TextSecure or ChatSecure (text) and RedPhone (voice) from Google Play, all free and excellent. WhatsApp also uses the TextSecure protocol (on Android only). On iOS, use Signal – Private Messenger or ChatSecure.

USE RESTRICTED PROFILES ON ANDROID

If you have a device with Android 4.3 or later, you should check out Restricted Profiles. In settings, head to 'Users > Add user or profile' and add a different profile for each person who uses the tablet. Not only does each user get their own unique collection of apps and documents (much like on Windows), it lets you lock things like in-app purchases and mature content away from kids.

ENABLE DEVICE TRACKING AND ANTI-THEFT ON YOUR MOBILE AND TABLET

There are plenty of apps for device tracking and anti-theft (Prey Anti Theft, Lookout, the many security suites for mobiles), but even if you don't want to use them you should use the anti-theft services provided by Apple and Google.

On iOS, get Find My iPhone on the App Store, then log into **icloud.com/#find** to see where your device is at any time, and lock it if it gets stolen. On Android, go to **www.google.com/android/devicemanager** and register your device using your Google ID. After that you can return to that page at any time to locate or lock the device.

FOR ALMOST COMPLETELY ANONYMOUS BROWSING, USE TOR

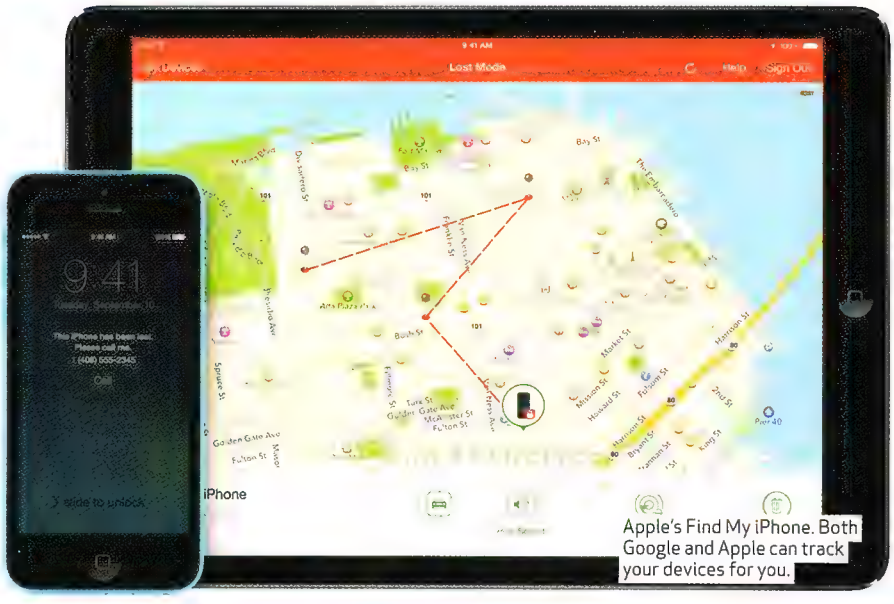
When it comes to privacy, not even a VPN can beat Tor. Tor routes your connections through several other computers on the internet, completely obscuring your location from your ISP, the government and the sites you visit. You can get the Tor-enabled web browser (based on Mozilla) at **www.torproject.org** for PC. Android users can use Orweb: Private Web Browser, available on Google Play.

FILTER OUT NASTY SITES USING DNS

The easiest way to stop your kids from accessing objectionable material, and anybody from accessing malicious web sites, is to use a secure DNS service. You can configure it on individual devices, or on your router to cover all your devices. It works for all your devices.

The most flexible secure DNS options is OpenDNS (**www.opendns.com**), which

> "VPNs are good for what ails ya. Even your ISP won't be able to tell what you're doing online."



Apple's Find My iPhone. Both Google and Apple can track your devices for you.

will give you a customisable "feed". You can choose by category what sites you want to restrict. If you want something simpler, however, we really like Norton ConnectSafe (**dns.norton.com**).

YOU DON'T NEED ENTERPRISE SOFTWARE TO ENCRYPT YOUR HARD DRIVES

Unless you have an Ultimate or Enterprise edition of Windows, you probably don't have BitLocker on your system. But there are great free alternatives available that let you encrypt specific files and folders or even your entire drive. If you have anything sensitive, you should use them. The best is probably VeraCrypt (**veracrypt.codeplex.com**). AxCrypt (**www.axantum.com/AxCrypt/**) is pretty great as well, with simple Windows/File Explorer integration.

GET TWO-FACTOR AUTHENTICATION FOR ALL YOUR APPS

Two factor authentification is becoming a real necessity, and you should enable it in every app that lets you – LastPass, Gmail, Facebook, Dropbox, you name it. The downside of doing that, of course, is that you'll possibly have a whole slew of different authenticators installed.

For iOS, Android and PC, however, we really like Authy (**www.authy.com**) which is a great way to consolidate your authentication needs across multiple platforms and apps. You can even use it on your PC (so you don't need to grab your mobile whenever you need authentication), and it will sync your authentication tokens across the cloud.

ROLL YOUR OWN VPN WITH HAMACHI OR DD-WRT

If encrypted communications when you're away from home is your goal, you can actually create your own VPN at home and dial back to it when your away.

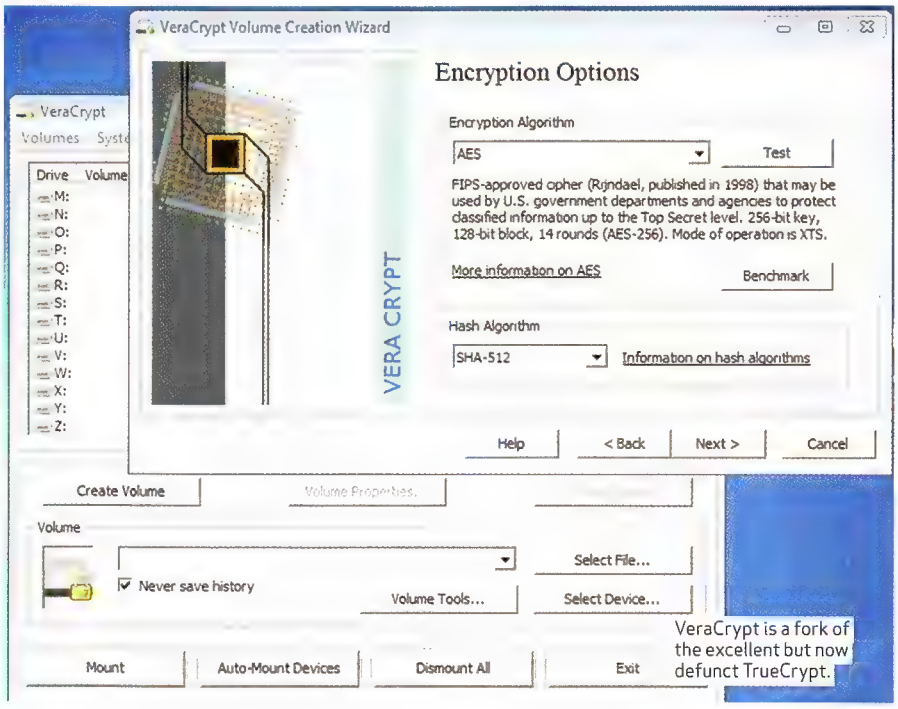
The best way to create your own VPN is to have a router that supports it. Some routers (like new ASUS routers) have it built in, but on others you might have to install third-party firmware like DD-WRT (**www.dd-wrt.com**). If you don't want to mess with your router's firmware, we really like Hamachi (**logmein.com**) as an easy VPN tool.

STOP ONLINE TRACKING EASILY WITH BROWSER ADD-ONS

Lots of sites try to track your online activity. Facebook and many ad services are notorious for it. There are great browser add-ons to stop that, however. The best is Disconnect (**disconnect.me**). Install it. Right now.

AUDIT YOUR ANDROID APPS

App permissions are something that most of us just ignore. It's too hard to bother checking. That's why you should download a tool to do it for you. Our favourite is Clueful from BitDefender, available from Google Play. It checks your app permissions as well as lists suspect apps based on an online database of known shady apps.



VeraCrypt is a fork of the excellent but now defunct TrueCrypt.

BACKUP TO A CLOUD SYNC DRIVE USING EVERYDAY BACKUP TOOLS

While there are dedicated cloud backup services like Carbonite and Mozy, it's also possible to make cloud sync drives like Dropbox, OneDrive and Google Drive into viable backup destinations. It's actually pretty easy – you install the local app for Dropbox, OneDrive or Google Drive. This creates a local directory for that service in your User directory. Anything you copy into that directory is uploaded to the cloud drive. Then you just go to your chosen backup tool and set the backup target as that directory.

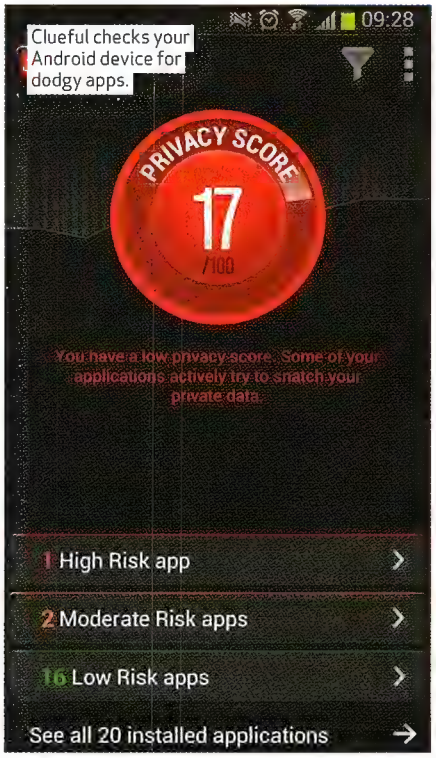
CREATE YOUR OWN FREE CLOUD BACKUP SERVICE WITH CRASHPLAN

One of our very favourite backup tools is CrashPlan, for one simple reason: it lets you set other PCs (either owned by you or someone else) as the backup destination. You and your friends and family can create your own cloud network where you backup your most important files to each others' PCs. Your data never gets placed on a stranger's server, yet you still enjoy the security of a cloud backup system.

CREATE A RECOVERY DISK EASILY

One of the most annoying things about new PCs now is that they don't come with recovery media on a physical disk. Often there's a hidden recovery partition, but if you upgrade your OS, it becomes useless.

Your best bet is to make a recovery disk yourself, ready for the inevitable crash. On Windows 8.x, there's the Recovery Media Creator; just open the Charms bar and do a search for 'recovery drive'. One Windows 7, there's the Create a system repair disc tool, hidden in the Backup and Restore section of the Control Panel.


Clueful checks your Android device for dodgy apps.
09:28
PRIVACY SCORE
17
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You have a low privacy score. Some of your applications actively try to snatch your private data.
1 High Risk app
2 Moderate Risk apps
16 Low Risk apps
See all 20 installed applications

Broadwell: it's business time

A helluva long time coming, Intel's new 14nm CPU family is finally here. Jeremy Laird takes a deep dive.

All systems are go with 14nm technology. If there's a single message that Intel wants to hammer into your head with its new family of Broadwell CPUs, it's this: 14nm is on line. Moore's Law lives on.

The reality isn't quite so simple. The reality is that Intel has fallen behind its self-imposed schedule of bringing out a new CPU architecture and then a new production process or die shrink in successive years.

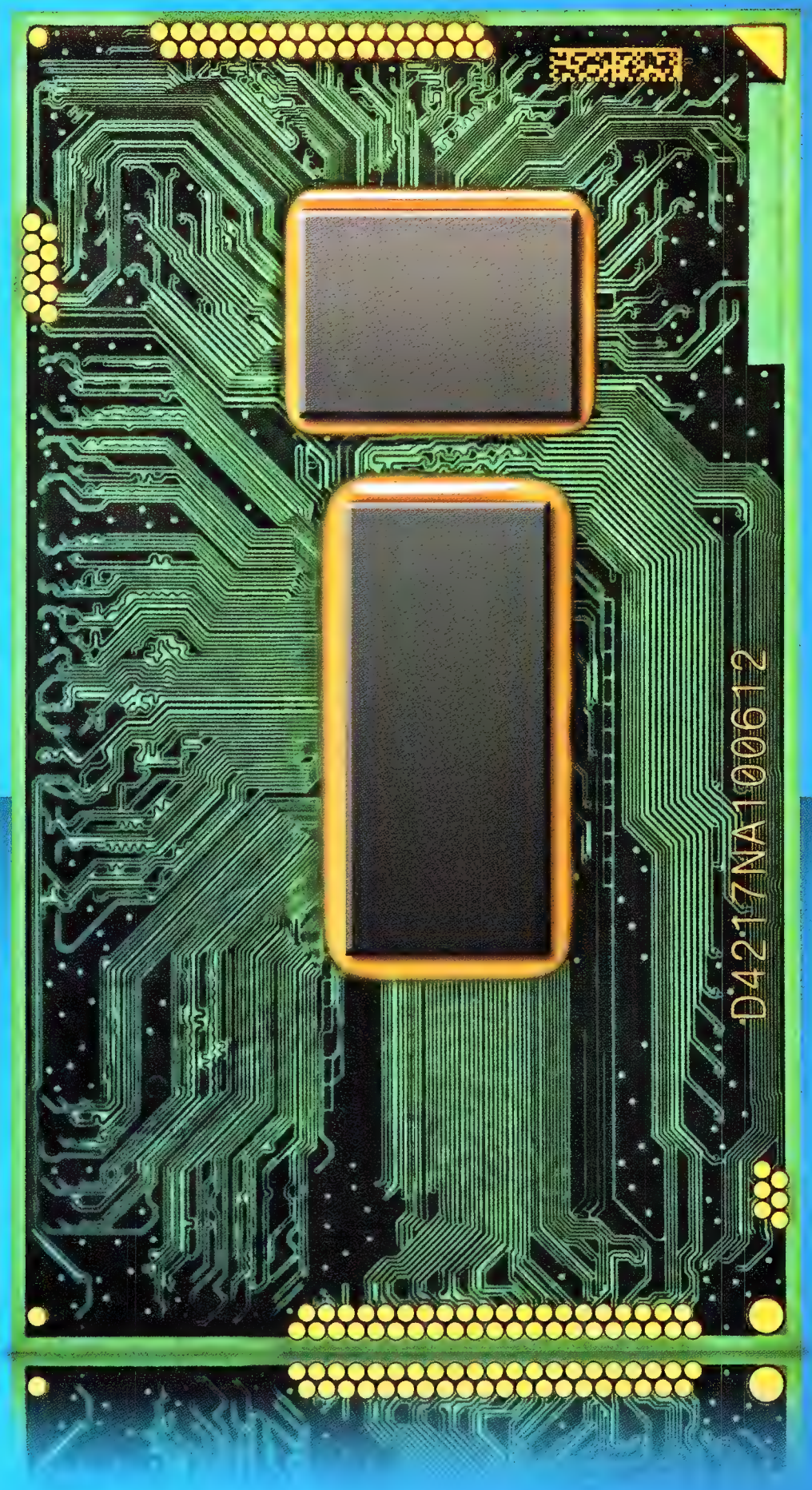
As we'll see, as chip features get ever smaller, the production process is becoming one hell of a challenge. As Intel's CPU designs become ever more refined, the new architecture bit ain't all that easy, either. Not if you're expecting substantial gains in performance. That's the context for the new Broadwell family. It's running late. And it's a lot to ask for it to be dramatically better than Intel's already-excellent CPUs. And yet there are reasons to be very glad it's finally arrived.

"As we'll see, as chip features get ever smaller, the production process is becoming one hell of a challenge."

For starters, thanks to Intel's tricky 14nm tech, Broadwell is by far the most energy efficient architecture Intel has ever created. No, that doesn't automatically translate into epic increases in performance. But it does mean you can have proper PC performance in form factors where it wasn't previously possible. Broadwell also represents yet another big leap in integrated graphics performance. And that begs the age-old question of whether great gaming performance on integrated graphics is at last finally possible.

On the other hand, Broadwell also reboots our ongoing concerns with Intel's strategy regards the pure-CPU portion of its chips. For some time now it's felt like Intel has been sandbagging on the CPU side, something that's been made possible thanks to the failure of its nearest rival, AMD, to offer serious competition.

Broadwell's lateness is also creating confusion in the context of the anticipated arrival of its successor, known as Skylake. As we go to press, Intel's only officially announced full details of the desktop Broadwell range. But we're expecting Skylake, including desktop derivatives, to arrive in the second half of this year. It's all a bit baffling. So let's start to make sense of Intel's 14nm mess.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Something has gone wrong at Intel. It was back in June 2013 that we first got our hands on desktop variants of Intel's Haswell family of CPUs. Now here we are roughly two years later and Intel has yet to announce desktop Broadwell processors.

Meanwhile the successor to Broadwell, an all-new architecture known as Skylake, is due later this year. For a company famed for its well-oiled and accurate execution of new product launches, of late at least, it's all a bit untidy.

It also makes a mockery of protestations from Intel that it's "on track for a healthy 14nm ramp." Undoubtedly and undeniably, 14nm has been problematical for Intel. But then the entire chip industry is increasingly struggling to keep Moore's Law on line. Not that we should be surprised by that – current chip technology is fast approaching a tiny thing that's going to be a big problem. The size of the atom. (See "No More Moore" on page 64.)

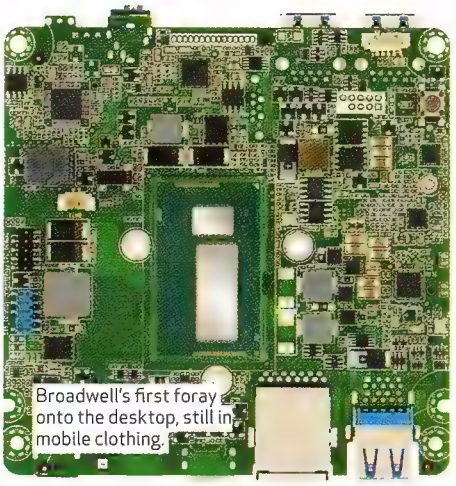
Anyway, Broadwell ought to have been available in full back in 2014. As it is, Intel only managed a trickle of dual-core mobile models late last year. At the same time, Intel says it's sticking to its plan of rolling out Skylake later this year. All of which begs two questions. What does Broadwell have to offer and is there any point to it for PC enthusiasts? Cue the Intel marketing machine.

PRODUCTIVITY PLUS?

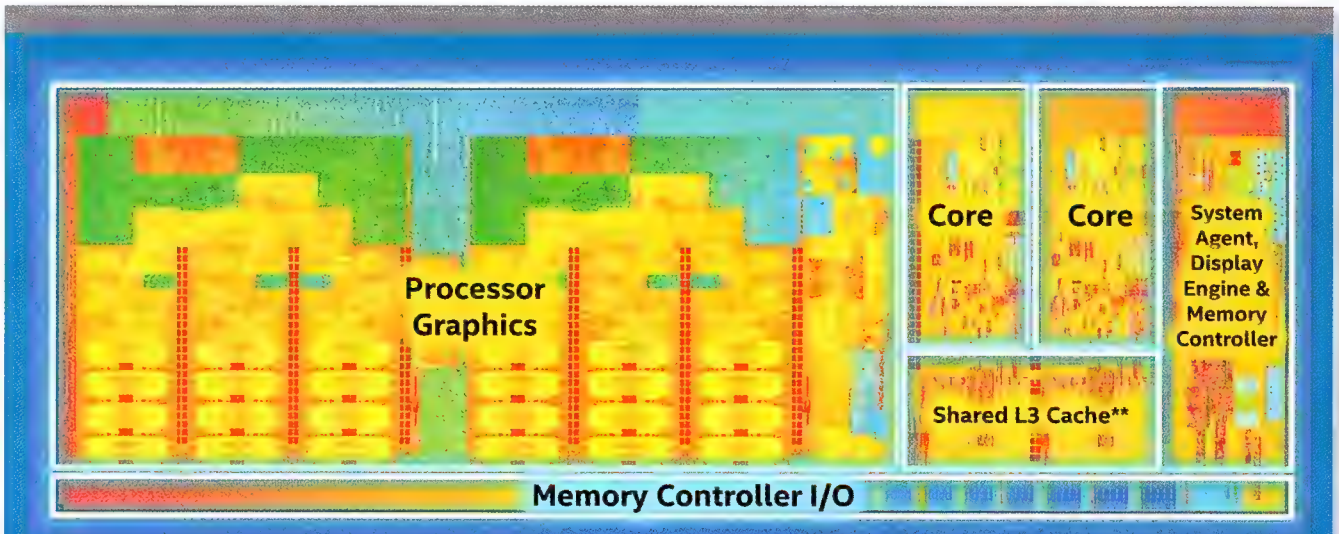
If you want the classic elevator pitch for Broadwell, it goes something like this: Broadwell is Intel's fifth-generation Core processor. It's the first Intel chip to be built on 14nm process technology and offers the smallest chip features ever. It's much more efficient, with better battery life, and you get much faster graphics. Conspicuously absent from the pitch are big claims regarding the CPU subsystem of the new chips. Hold that thought though, we'll come back to it shortly.

First, let's knock about a few numbers that get to the heart of what Broadwell is about. Unfortunately, Intel has yet to release proper numbers or even model names for any desktop Broadwells, or even quad-core mobile Broadwells. So the best data available relates to dual-core mobile chips. We'll compare the new Core i7-5600U with its direct predecessor, the i7-4600U. It's a high-end dual-core model with the biggest available graphics subsystem. It packs 35% more transistors than before at 1.9 billion, and yet the new 14nm process means it's also 37% smaller in terms of die size.

Its graphics is claimed to be 22% faster than the 4600U, hardware



Broadwell's first foray onto the desktop, still in mobile clothing.



The core of the problem

The future's bright. The future's massively multicore.

So went the Intel PR pitch at multiple installments of its IDF techfest. Today two cores, tomorrow four, in years to come more than you could count.

Recently? Not so much. That's reflected in the fact Intel's mainstream processors still only have four cores, nearly nine years after its first quad-core CPUs were announced. So, what the hell happened?

There are two ways to look at this. Firstly, Intel is making CPUs with loads of cores, it's just not putting them into PCs. Want a CPU with 18 cores? Intel makes one for servers, albeit costing thousands. At best you can have an eight core CPU in the high-end LGA2011 platform which is really just rebadged server technology, anyway.

You could also argue those cores have migrated to graphics. All of Intel's mainstream CPUs now have integrated graphics and if you take a peak at, say, the die shot of a dual-core chip with the big graphics core, it's at least two-thirds graphics. A quad-core model would be roughly 50/50. And, of course, that big graphics block has 48 execution units, which you could style as cores — suddenly you've got a 52-core chip.

Indeed, that graphics part of the chip can be used for some workloads that are traditionally CPU fare, such as video encoding. The problem with that view is that if you care about gaming, it's pretty much irrelevant. You'll have a proper discreet GPU and the gunk Intel integrates onto its CPU simply doesn't factor. That includes Broadwell's beefed-up graphics, as good as it is by integrated standards.

No, however you slice it, Intel's mainstream CPUs are still four cores. Nearly a decade on, that's disappointing.

accelerated video encoding is a remarkable 50% faster, and battery life goes up by around 1.5 hours. Impressive. Less wonderful are the numbers relating to what you might call pure CPU performance. Intel is only claiming a 4% improvement in productivity performance.

There are several reasons for that. Firstly, Intel's x86 CPU cores are now very finely honed indeed. The low-hanging fruit in terms of performance optimizations were ripped from the tree long ago. If there's anything left dangling, it's just some very small stragglers on the hardest-to-reach branches.

What's more, Intel has reduced the maximum Turbo frequency of the 5600U by 100MHz to 3.2GHz. So that modest 4% gain is actually achieved at a lower peak operating speed. However, while the top Turbo speed is down a little, the base frequency is up by a hefty 500MHz to 2.6GHz. That should help in terms of sustained performance in thin and light laptops where heat can build up and prevent you from accessing the Turbo function. In that scenario, we reckon the 5600U might well be 20% quicker for CPU tasks than the old 4600U.

Of course, we also need to remember that Broadwell is a Tick in Intel's Tick-Tock chip development parlance. That means it's all about the die shrink from 22nm to 14nm; it's not meant to bring a dramatically new architecture. That said, Broadwell is being styled as a Tick-plus, and so more than a simple die shrink. But the "plus" bit is more about graphics and other features. In most regards, the CPU cores are carried over.

Anyway, that extra 1.5 hours of battery life is a big deal. It reflects an overall efficiency boost that will allow proper PC performance to be squeezed into yet smaller form factors. At this point in the Broadwell product cycle, it's early days. Keep your scanners peeled for ridiculously thin and light notebooks as well as just possibly some interesting tablets. We'd certainly love to see a Microsoft Surface with the most powerful Broadwell graphics options inside.

GRAPHICS GRUNT

While we're on the subject, what of the new graphics technology in Broadwell? Power efficiency aside, it's got to be the most interesting aspect of the new architecture. In fact, it's the latest in a long line of improved integrated graphics from Intel in recent years. Intel claims Broadwell represents a 100-fold increase in integrated graphics performance since 2006.

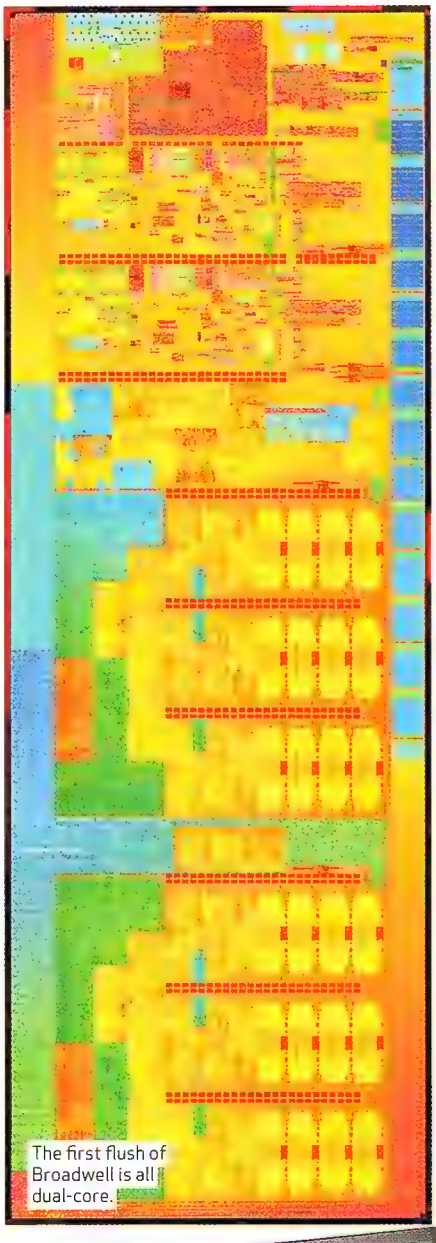
That sounds like an incredible leap. However, the starting point in 2006 was so low that the 100x metric doesn't actually mean much. No, what really matters isn't how much faster Broadwell graphics is compared to something ancient and absolutely awful. What matters is whether you can game on it today.

On paper, the changes for Broadwell don't seem that dramatic. The basic graphics core gets a bump from 20 execution units to 24 and the fastest configuration goes from 40 to 48 units. Then you note that Broadwell graphics is a continuation of Intel's so-called Gen7 graphics architecture from Haswell and previous families of chips. And you might conclude we're looking at worthwhile improvements, no doubt, but hardly the stuff of 100-fold leaps in gaming performance.

But that wouldn't be entirely fair. Intel has given Gen7 a pretty hefty overhaul for Broadwell. It goes well beyond simply throwing a few more execution units at the problem of faster frame rates. For starters, Broadwell has been updated to support the latest graphics APIs. That specifically means Direct3D 11_2 now and support for Direct3D 12 (often simply referred to via the multimedia super set API that is DirectX 12) when it arrives with the final retail build of Windows 10.

Intel has also confirmed that Broadwell graphics is OpenCL 2.0 compliant, including shared virtual memory. So it really is a thoroughly modern graphics design, plus has all the general-purpose computing bells and whistles, too.

But it's the structure of the rendering pipeline where things get more interesting for we gaming addicts. Intel's graphics cores are subdivided into "slices." For Haswell, each slice had 10 execution units.



The first flush of Broadwell is all dual-core.

Broadwell's graphics revamp is far greater than it seems at first.

For Broadwell, this drops to eight.

If that sounds like a step backwards, the point is that each slice has shared resources in terms of cache memory and sampler units. With fewer execution units per slice, you get more cache and more sampling for each execution. Individual sampler performance has also risen, the upshot of which is a 50% bump in overall sampler performance. Intel has also tweaked the ROPs, or render outputs, and rasterizers to up fill rates.

LUCK OF THE IRIS

The payoff from all of this is that the new mid-sized graphics core with 24 execution units, known as GT2, has nearly closed the gap with the old big graphics core, known as GT3, in Haswell. But in both Bioshock and GRID 2, Broadwell GT2 is remarkably close to Haswell GT3.

What it's not, however, is what we'd really call fully gameable. In both games, average frame rates at 1080p and full detail with 4x antialiasing enabled are well below 30 frames per second. Even if you double the frame rates for the 48-unit Broadwell GT3, which we haven't tested yet, and add a bit for the eDRAM memory that comes with the very fastest version, known as Iris Pro, we're still talking marginal frame rates at 1080p in what are not exactly the most demanding games.

Actually, while we're talking Iris Pro, it's worth noting that both Intel's strange branding and its awkward positioning of its GPU technology looks like remaining with Broadwell. On the branding side, Intel is keeping the HD Graphics and Iris split. What's confusing is that Broadwell CPUs with the fastest HD Graphics 6000 solutions will get the 48-unit core, just like Iris 6100 and Iris Pro 6200 graphics. To us it would be easier for everyone to understand what they're buying if the 48-unit graphics was exclusively branded Iris.

As for the positioning, the problem has been that Intel has tended to restrict its fastest graphics to its higher-end CPU configurations. And that doesn't make any sense, especially on the desktop, but even in laptops. That's because any system with an expensive, relatively high-end quad-core CPU is going to have a discrete or plug-in video card, making the specification of the integrated graphics irrelevant.

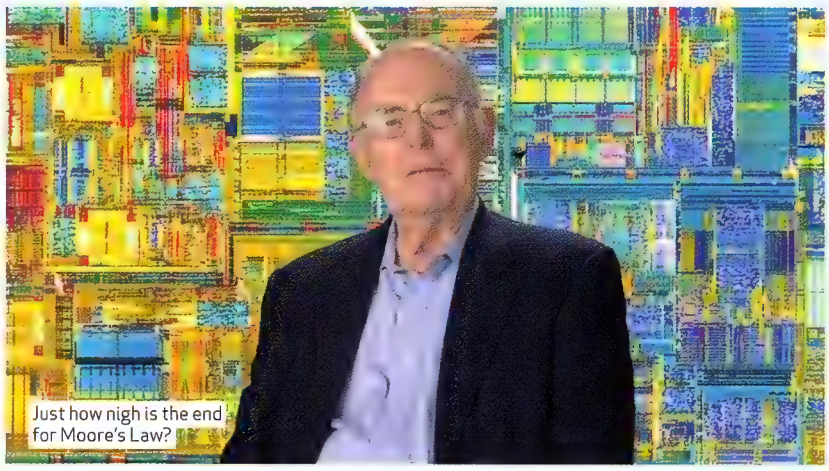
Instead, it would would make much more sense to have a cheap dual-core CPU paired with the quickest graphics configuration and end up with something capable of a bit of light gaming for not all that much money. At least, it would make much more sense for us poor gamers and computing junkies. The problem is that big graphics means big computer chip.

Intel does do a dual-core chip with the big 48-unit graphics core for laptops, but you only have to glance at the die shot on page 62 to understand the problem. The graphics portion is huge. It's at least two-thirds of the chip, maybe more. The consequence is a mere dual-core PC processor with nearly two billions transistors.

Even taking into account the savings that come with a die shrink to 14nm, that pushes up the production cost and makes it tricky to sell a low-end model with the highest performing graphics. Eventually, graphics and CPU functionality will probably cease to be in any way distinct and the problem will disappear. For now, it means we can't quite have the precise configurations we'd prefer.

REALSENSE AND SENSIBILITY

If efficiency and graphics are the big deals, is there anything else to get excited about? Intel is talking up "enhanced capabilities" for Broadwell and they fall into a few categories. The first you might call more "natural" interactions.



Just how nigh is the end for Moore's Law?

No More Moore?

The days of shrinking chips enters a final decade or so as size of the atom rushes into view.

Moore's Law is the observation, first noted by Intel co-founder Gordon Moore way back in the 1960s, that transistor density in computer chips tend to double every couple of years.

Put another way, it means the complexity and power of a computer chip of a given size doubles every two years. That, of course, gives rise to an exponential explosion in computing power over an extended time frame. Two becomes four and then eight, 16, 32, 64, 128, and so on. That's why today's desktop computers sport terraflops of raw compute power and why smartphones are faster than yesteryear's PCs.

But for how much longer? A bit like constant prognostications that fossil fuels will run out any day now, you could say reports of the demise of Moore's Law have been greatly exaggerated over the years. And yet with both oil and Moore's Law, it can't go on forever. One day the oil will run out. And one day Moore's Law will hit the wall.

With oil, it's hard to say exactly when. Nobody really knows how much oil is left in the ground. For existing chip technology, it's a little easier. The width of the atoms used in current chip production are roughly 0.2nm. The smallest atoms are hydrogen and they rock in at about 0.1nm. Today, Intel is selling processors with 14nm features. Immediately, then, there are hard, physical limits to how small you can make the transistors or gates within chips.

That doesn't necessarily limit the progression of computing per se. But at the very least we'll need a new paradigm, be that quantum computing or something else. Indeed, there are clear signs that the computer chip industry is already struggling to keep Moore's Law on track as feature sizes bear down on that final limitation — the size of an atom.

IBM recently gave up making chips, for instance, and the cost of the facilities or foundaries for chip making are rising in an exponential fashion that almost matches the increasing power of the computers they enable. There's at least a decade of further progress available. But after that, it really can't go on too much longer.

©Chemical Heritage Foundation

Gesture-recognising laptops with Intel's RealSense.

According to the Intel spiel, with the PC we've gone from plain old text input to graphical user interfaces and then touchscreens and voice control. What's next? Adding senses to the PC, namely the ability to recognise gestures and facial expressions along with more natural language recognition. Now this isn't really a feature of a Broadwell CPU, but it does require processing power. And if you're going to have that processing power available in today's increasingly mobile form factors, you need the improved efficiency that Broadwell brings.

Intel is actually getting into this game itself with its own technology, known as Intel RealSense, a feature set based around 3D-capable sensors. There's a conventional colour camera in the centre, flanked by an IR laser projector and an IR camera. Together, these allow objects to be scanned for depth and dimensions. Finally, there's a stereo microphone array.

Put these sensors together and you have a system that supports gesture control using hands and fingers, facial expression detection, head tracking, and object scanning, the latter enabling model creation for 3D printing. It also includes a Voice Assistant with basic offline and more sophisticated online components similar to Apple's Siri and Microsoft's Cortana voice control systems.

If that sounds like the kind of high-concept technology Intel often touts but in reality fails to bring to market, well, RealSense is actually shipping today in Dell's Venue 8 tablet along with notebook PCs from ASUS and Lenovo. That said, we've yet to see it in action, so we can't judge whether it'll catch on. What we can say is that Intel is up against some seriously stiff competition from Apple, Google, and Microsoft in this area.

SKYLAKE LOOMING

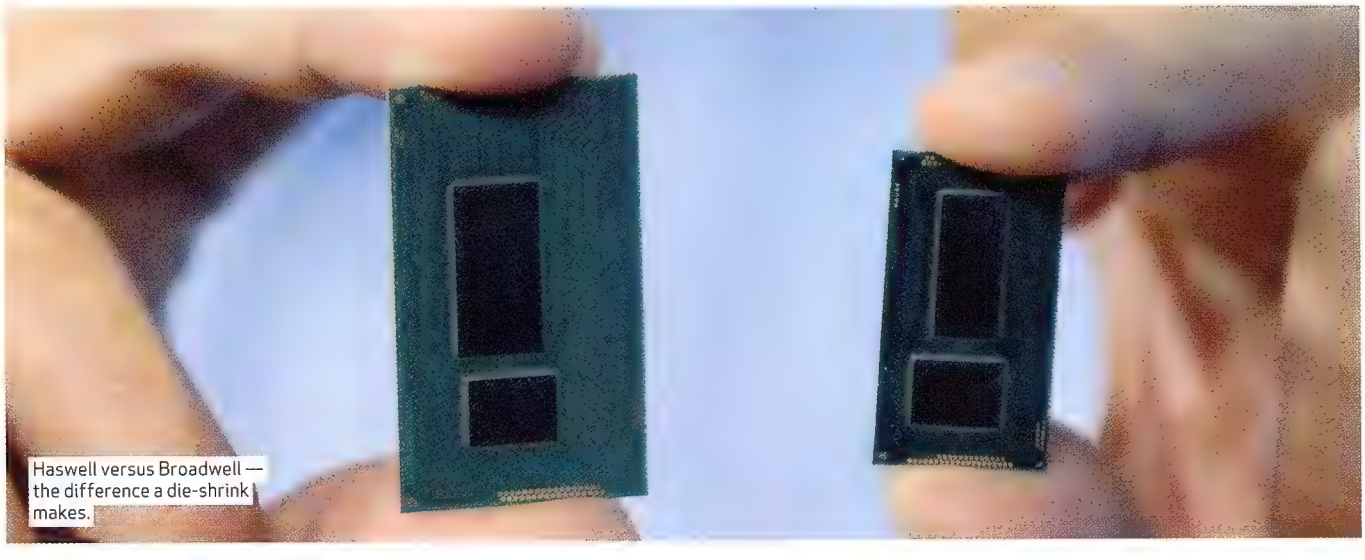
So, that's Broadwell itself covered off. The obvious question is what's next? Actually, that's a more critical question than usual since Intel's 14nm derailment means that by the time desktop Broadwells arrive along with quad-core mobile models, the follow-up family of chips, known as Skylake, will be imminent too.

Full details of Skylake haven't been released, but if we combine what Intel has revealed with the best of the leaks and rumours, we can get a pretty good idea of what to expect. Firstly, Skylake is an Intel "Tock" and that means a new architecture on the prevailing production process, which is now transitioning to 14nm.

As ever, graphics is a major part of the Skylake package, both literally and in terms of importance. Rumour has it Skylake will introduce a new "GT4" spec graphics configuration with no fewer than 72 execution units. That means nine of those eight-strong execution-unit slices instead or six, or a straight 50% boost in computational complexity.

Normally, we wouldn't be hugely excited at the prospect of some far-off integrated graphics core. But Skylake is just around the corner and if it really does have 72 units, it's going to be massively quicker than today's best Haswell graphics.

That said, arguably more interesting are the platform developments that come with Skylake. First up, there's a



Haswell versus Broadwell — the difference a die-shrink makes.

Intel's wireless display technology, WiDi v5.1, promises lower latency than ever.

Can Skylake's GT4 graphics give us gaming in such small form factors?

Broadwell factfest

In our quest to dive deep into the architectural nether regions of a new CPU family, it's sometimes easy to miss out on some fun little factoids, so here you go

First, Broadwell is a proper 4K chip. No, not for gaming. Even Nvidia and AMD's finest dedicated GPUs struggle with that. No, we're talking 4K video displays and video decode. Broadwell has H.265 and VP9 4K decode capability and can output at 4K 60Hz assuming motherboard support. Which is nice.

While we're talking displays, Broadwell coincides with an update to Intel's wireless display technology known as WiDi. Version 5.1 is said to tout full gaming support, for which read lower latency than ever. To be frank, we'll want to try that for ourselves. Intel has also added a WiDi remote for easy dual-screen management. But here's the really interesting bit. WiDi now supports 4K. Again, this is something we really want to see first hand before getting too excited. It's the sort of thing that could be incredible. Or it could be a feature that looks great on paper, but requires such perfect signal integrity that it barely ever actually works. Still, you can get a WiDi v5.1 adaptor for your TV for under $50, so it's certainly not expensive technology.

And finally... did you know that Broadwell chips will be going into Chromebooks as well as Windows laptops? As Windows comes under more pressure from Apple's iOS, and Google's Chrome and Android operating systems, Intel is increasingly in favour of finding ways for its chips to work with a broader range of software. With Chrome apps and features increasingly offering an offline mode, having proper CPU power in a Chromebook could prove ever more worthwhile.

new socket, LGA1151, which breaks backwards compatibility. Where desktop Broadwells will drop into existing Intel 9 Series motherboards, Skylake chips will need a new mobo.

If that's the bad news, the good news is that the new socket means a properly new desktop platform along with new 100 Series chipsets topped out with the upcoming Z170. Reportedly, both Skylake and the new chipsets will support both existing DDR3 memory and the new fangled DDR4 stuff that's so far been restricted to Intel's high-end LGA2011v3 socket and CPUs. However, actual motherboard implementation will see only one memory type appearing. We won't see any boards that can take both memory types.

DDR4 probably isn't a big deal for mainstream desktop gaming rigs. But the boosted bandwidth should help keep those mooted 72 execution units in the new graphics engine fed with frame data. The other headline grabber is a bump for PCI Express lane availability, up to 20 lanes from 16. That matters because storage subsystems – specifically SSDs – are moving to the PCI Express-based M.2 interface. For dual-card multi-GPU SLI or Crossfire graphics, you want at least eight lanes per graphics card. With an M.2 drive pinching a few of your 16 lanes, there's a problem. With 20 lanes, you've got four spare for a couple of fast SSDs. Perfect.

However, where things get really complicated is the relationship between Broadwell and Skylake on the desktop. Broadwell's lateness combined with Intel's plan to stick with its schedule for Skylake has created some distinct weirdness. According to leaked Intel roadmaps, this is what it's going to look like. Broadwell desktop CPUs will be the unlocked K-series models only. There won't be any mainstream locked Broadwells on the desktop. Instead, those slots, which represent the bulk of Intel's desktop offerings, will come from the Skylake family.

It's an odd situation and leaves a lot of questions unanswered. For instance, will there be unlocked Core i5 Broadwells with no Hyper-Threading, as there have been for several generations? And what will Intel call these chips? Will it launch what it calls fifth and sixth-gen Core processors? Or will it simply brand them all as fifth generation?

Then there's the not-so-minor matter of multiple platforms and multiple sockets that lack cross compatibility. It's bad enough that Intel now splits its desktop offerings into separate mainstream and high-end offerings. It now seems that, for a while at least, you'll have to choose between two mainstream platforms: the existing LGA1150, which Broadwell CPUs require, and Skylake's new LGA1151 socket.

What's more, the way Intel has done this is probably the opposite of the ideal. If you've forked out for an expensive unlocked chip, you're likely to want the latest platform technology with those extra PCI Express lanes and DDR4 support. But those will only be available with locked Skylake chips.

DOUBLE TROUBLE

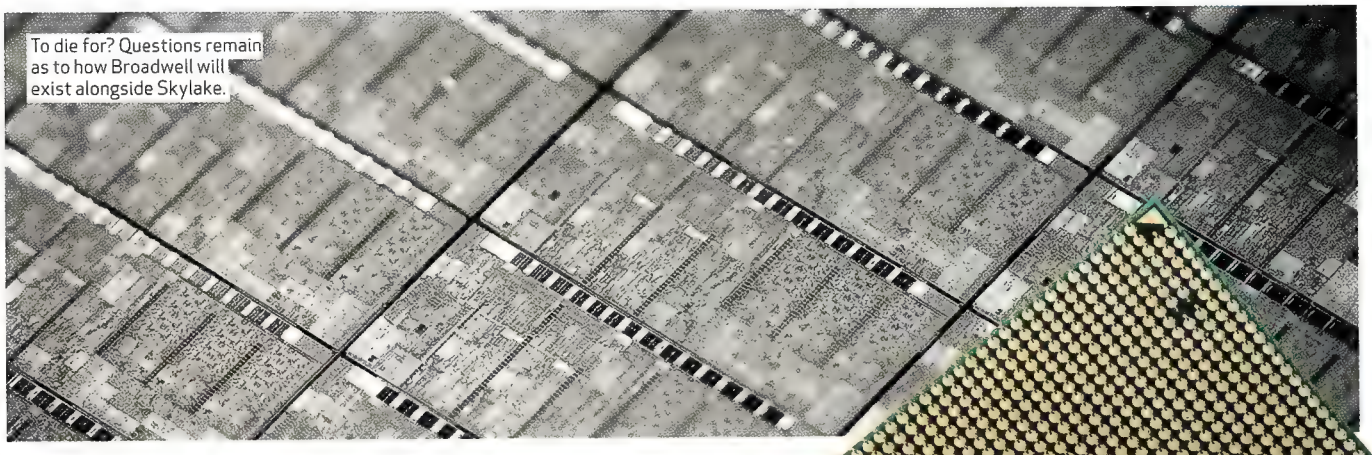
Whatever, it will be very odd to have what is an older architecture in Broadwell sitting above the newer Skylake models in Intel's hierarchy. At the very least, it possibly means that Skylake's CPU cores won't be anything to get excited about. After all, unlocked

Broadwells selling as range toppers will need to be faster than their cheaper and locked Skylake siblings or the whole thing really will come tumbling down. All will become clearer in the coming months, but it's odds-on that Intel will have to pull some marketing tricks to make sense of this weird mishmash of new products.

As for what happens after Skylake, we really are into crystal ball territory. There are a few known facts. Skylake will be followed by a family of 10nm die shrink chips called Cannonlake. Due in 2016, they'll come with another new platform, the 200 Series chipset, and pair with DDR4 only.

All of which means we've mixed feelings about Broadwell. We're disappointed that it likely won't push on Intel's game for pure CPU core technology. But the power efficiency and graphics look like a big step forward and it's nice that it should drop straight into existing 9 Series motherboards, albeit with a BIOS update required.

How will it all work with Skylake arriving at nearly the same time? Well, that remains far from clear and could determine whether Broadwell makes a mark or turns out to be too little too late. ■



To die for? Questions remain as to how Broadwell will exist alongside Skylake.

Dare we ask about AMD?

Intel's only rival in the PC processor market continues to strive, and struggle, to keep up with the advances.

Every time you think AMD is about to drop dead, some good news pops up. But you can be just as sure that any time things are looking up, some disaster or other lies just around the corner.

So where does that put AMD today? The context is Intel's ceaseless march. While we nitpick over its delayed 14nm technology, there's no denying Intel has broadly stuck to its Tick-Tock strategy of releasing new CPU architectures and new production processes in alternating years.

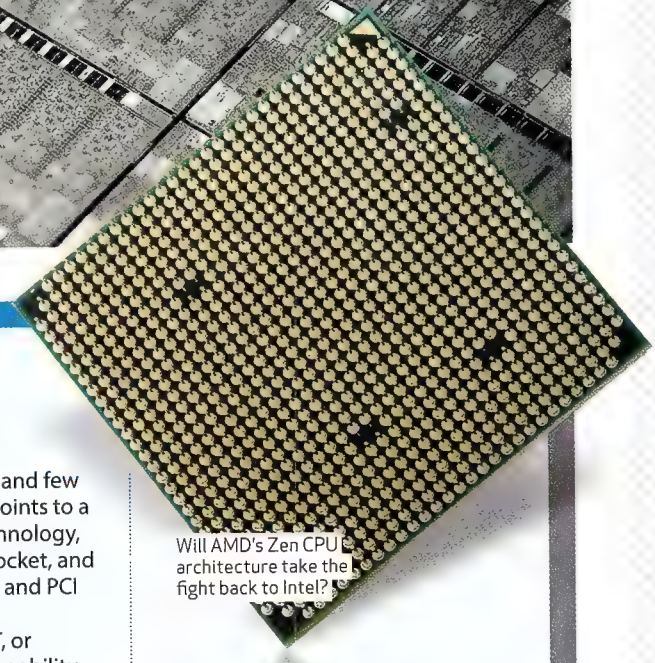
AMD, meanwhile, doesn't seem able to react. Its current performance CPUs are based on the Bulldozer architecture that appeared in 2011 and was supposed to take the fight to Intel's Core. It's been slightly revised on a few occasions, but there's no getting round it — Bulldozer is a failure. In fact, we'd say it's so bad that AMD would've been better off sticking with the Hammer CPU core that dates back to 2003 and was launched under the Athlon 64 branding.

AMD currently has little to excite PC enthusiasts or gamers. It's been pegged back to chips that just about make sense on account of being cheap. That means tight margins and narrow profits. Not good. Enter Zen, its new x86 CPU architecture. It's due out in 2016 — though on AMD's past form it'll probably miss that target — and few details are known. But rumour points to a launch on 14nm production technology, compatibility with AMD's FM3 socket, and support for both DDR4 memory and PCI Express 3.0 interconnects.

It's thought Zen will offer SMT, or simultaneous multithreading, capability similar to Intel's Hyper-Threading tech. It will also likely be a step away from the modular architecture of Bulldozer, with its pairing of what you might call two small cores into a module with shared resources, back to a more traditional big core approach with more emphasis on IPC, or instructions processed per core and per clock cycle.

Another detail is a TDP, or total design power, for the first Zen chips of up to 95W, combined with a greater focus on power efficiency, which has been one of Bulldozer's most conspicuous failings. Taken together, the combination of 95W TDP and increased efficiency confirms that AMD intends to compete at the performance end of the market.

If all this sounds similar to Intel's strategy since its switch from the high-clocking Netburst Pentium 4 architecture to the IPC-tastic Core processors, even the code-name for the first Zen processors, Summit Ridge, sounds distinctly Intel-ish. Arguably, however, Zen will succeed or fail more on execution than broad strategy.



Will AMD's Zen CPU architecture take the fight back to Intel?

Bulldozer's modular architecture could have been a winner. But it was poorly executed from day one. For a company with limited resources like AMD, rectifying that initial mis-step has proven pretty much impossible. The final question is whether Zen is AMD's final roll of the dice. If Zen fails, does all of AMD go down? Possibly. It will depend on AMD's plans to also launch its own chips based on the ARM instruction set, a new architecture known as K12.

A Zen failure will almost certainly kill off AMD as a vendor of x86 processors. If that happens, AMD will be left trying to make a mark on the viciously competitive market for ARM processors. And for the record, AMD probably can't survive solely on the strengths of its graphics chips. If the CPU business collapses, AMD is unlikely to survive.

how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

Upgrading memory is rarely a bad thing, but you'll need to thoroughly check compatibility for laptops.

HARDWARE

UPGRADING LAPTOP MEMORY

I have an HP G62 laptop with Windows 7 Home Premium, a Core i3 CPU and 4GB of memory. I would like to upgrade the memory to 8GB, but I would like to know if the CPU will work with the upgrade. And will it improve the performance of the PC?
Edmond January

More memory will always improve performance. Sometimes it will only improve performance a tiny bit, or not enough to justify the upgrade cost, but no PC ever got slower after a RAM upgrade. There are well over 300 models in the G62 family, and most will take 8GB, but we'd suggest going to **www.crucial.com** and using its configuration tool to find out for your specific model.

If your hardware supports 8GB, the next question is: does your OS? Windows 7 Home Premium, like most versions of Windows, comes in 32-bit and 64-bit versions. To find out what you're running, click Start, right-click Computer and choose Properties. It will say which version you have next to System Type. If it's 64-bit then Windows will make use of all 8GB. If it's 32-bit then the benefits of more than 4GB become much more situational. Upgrading to Windows 8 64-bit and 8GB RAM is what you should do in this case, because, you know, it's 2015.

WINDOWS

PACK PROS AND CONS

I am in the process of planning my next PC. It's going to be a self-build and I have finally settled on the specifications for most of the hardware. What I'm stuck on is which version of Windows I should get. Which do you recommend out of Windows 8.1 Pro and Windows 8.1 Pro Pack?
Derrick Pugh

They aren't really different editions. The Pro Pack is just an upgrade option for those running the core version of Win 8.1 to give them the Pro features (with one extra, which I'll get to in a minute). Regular 8.1 has an RRP of $149 and 8.1 Pro is $259, although both are obviously available a bit cheaper if you shop around. That extra $110 gives you file and disk encryption, remote desktop assistance, group policies and virtual hard disk booting. If you don't know what any of those are, then you likely don't need them.

The one extra thing in the Pro Pack is Windows Media Centre. This used to be bundled with Windows 7 but was removed from Windows 8 so that Microsoft didn't need to pay the licence fee for the DVD codec that they didn't think anyone cared about anymore. If you have Windows 8.1 and you want Windows Media Center, the only way to get it is to pay $129 for the Pro Pack. But if you already have Win 8.1 Pro, you can add Media Center for $10. Or, just get the regular edition of Windows 8.1 and use a free third-party media player like VLC (**www.videolan.org**).

OFFICE APPS

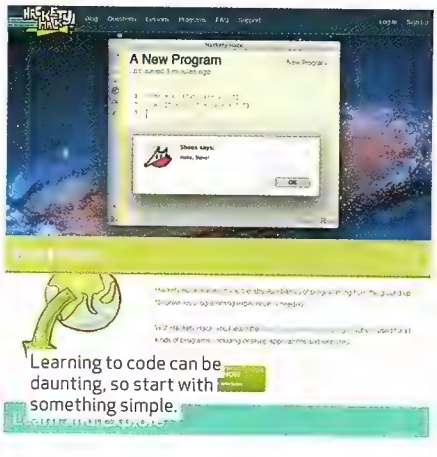
PROGRAMMING WITHOUT THE WORK

I know that you're constantly encouraging us all to learn how to program — and it's certainly something I would like to figure out someday — but for most of us mortals it is too daunting a prospect right now. But I do have some geometry and maths problems that I would like to solve that are too difficult or tedious to work out on paper. The largest prime number where its sum, product and length are all prime, for example. I'm using an Open Office spreadsheet for this but I have run into a problem. I want a formula that will give me the sum of a range — SUM(A1:A10), say — but I want the range to come from the value of another cell. I have tried just putting A1:A10 in cell B1 and writing SUM(B1) but this doesn't work.
Alex Papadopoulos

Naturally it doesn't. Although you might think it's obvious that the contents of cell B1 refer to a range somewhere else on your spreadsheet, computers are a good deal more literal than that and you need to tell them explicitly what you want to do. This is actually the fundamental skill of programming: expressing your problem as a completely unambiguous set of steps. If you are using spreadsheets to solve maths puzzles for fun (I'm assuming you're doing this for fun, since searching for prime numbers with interesting properties is pretty much only ever something you'd do for the sheer hell of it), then you probably already have the right mind-set.

The problem with programming today is not that computer languages are harder than they used to be, it's just that the computers they run on are much more complicated and so the development environment is more daunting. I still find the process of setting up the interface and build settings for the compiler by far the most off-putting part of learning a new language. Start with something simple, like our Java masterclass. Or for something a bit simpler you can try Hackety Hack (**www.hackety.com**), a programming environment designed to teach Ruby. It's free, easy to set up and you'll learn Ruby, which is a 'proper' programming language.

Anyway, for your spreadsheet, you need to use SUM(INDIRECT(B1)).
Luis Villazon



Learning to code can be daunting, so start with something simple.

Dogs may be watching, but they're apparently rubbish at dual-screen setups.

HARDWARE

ALL OUT OF OPTIONS

I have a machine that I built myself out of top quality parts and lots of love and attention. It has served me well running Windows 7. Recently I rebuilt it completely, switched the BIOS mode to UEFI on my Intel DX79SR motherboard and installed Windows 8. I have enabled UEFI fast booting, which works great, but I want to tweak some of the other UEFI settings using the Advanced boot options menu in Win8. And that's where I come to you, because the UEFI Firmware Settings option is missing from the Advanced options menu. How can I get Windows to recognise the UEFI settings?
Jim Greer

Ah, that's easy – you just need to get a different motherboard. This is because the DX79SR doesn't support UEFI. At least I don't think it does. I haven't got one in front of me to specifically check. But there are some clues, if you know where to look. The first is that the UEFI Firmware Settings option is missing from the Advanced options menu in Windows 8, which you have discovered for yourself. That by itself really ought to be all you need, but just to be sure, I have scoured Intel's documentation for the DX79SR – both the end-user manuals and the more technical stuff intended for system integrators and repair technicians. None of it mentions UEFI. Now Intel doesn't specifically say anywhere that this motherboard doesn't support UEFI, but it's probably a little unreasonable to expect manufacturers to provide a comprehensive list of all the things that your motherboard can't do. It would be a pretty long list.
Luis Villazon

HARDWARE

A BETTER MOUSETRAP

I recently finished the single-player campaign of* Watch_Dogs *and yesterday I started playing multiplayer for the first time. I have a dual-monitor setup, which I use for flight sims, but in* Watch_Dogs *it's really annoying. The mouse keeps leaking over on to the second screen if I get too enthusiastic. I don't remember this ever happening in single-player, but maybe things there were just less frantic. I've tried reinstalling all the usual suspects, but it hasn't made any difference to the problem. Is there a reason this might be a glitch in multiplayer?
Adam Dulles

Finding the reason is probably not the answer (or droid) you are looking for; you want the solution for it. (We probably care slightly more about the reason for the (presumed) glitch than you, because finding the reasons for glitches is kind of our whole jam. But even we're not that bothered.) This is a very vague set of circumstances that make reproducing the error extremely difficult. I don't know what kind of mouse you have or which version of Windows you're running or what 'the usual suspects' implies. So let's both agree to ignore the reasons for the glitch and focus on some fixes. We have two. Fix 1: run *Watch_Dogs* in full screen mode – this should automatically lock the mouse input to the primary monitor. Fix 2: use one of the many multi-monitor utilities that have a 'mouse-trap' function to do the locking for you – MurGeeMon, for instance (**www.murgee.com/MurGeeMon**).
Luis Villazon

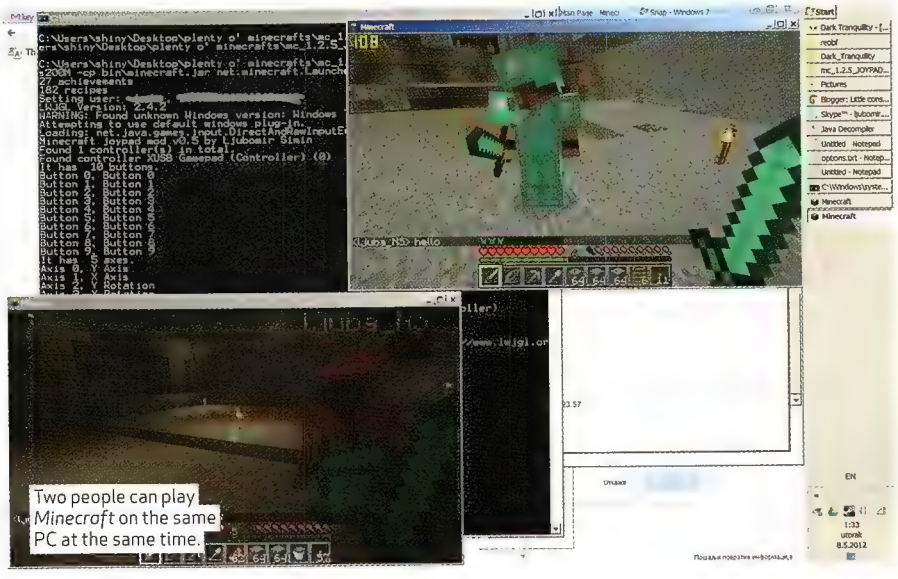
GAMING

COOPERATIVE CREEPERS

Is there a way to run* Minecraft *as a multiplayer game on the same PC without an internet connection? My six-year-old son isn't ready for the internet yet (or at least, I'm not ready for him to be on it) but I'd like to be able to join in with him when we are digging caves and punching trees.
James Caulfield

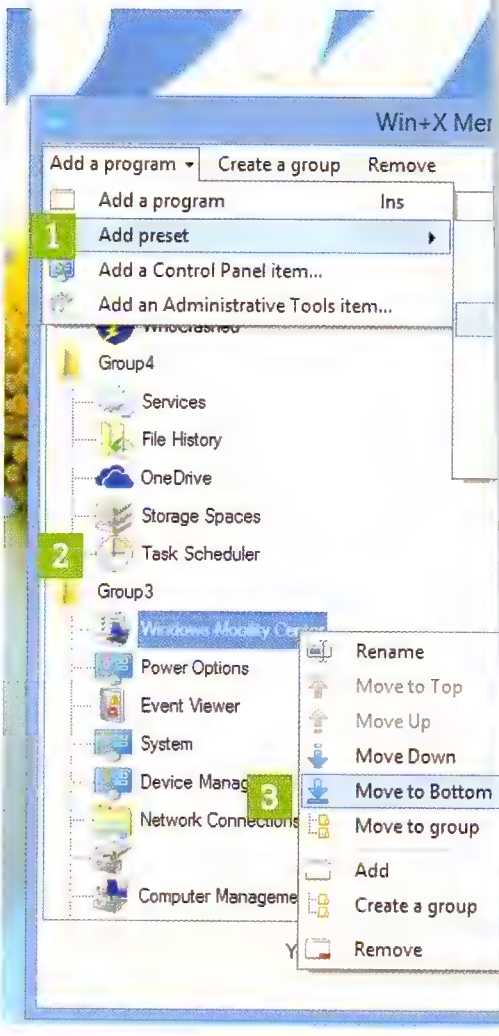
The bad news: there will probably never be a time when you feel your child is ready for the internet. The possible trouble that kids could get into expands much faster than our willingness to accept it. Even at age six though, we're not sure it is realistic to adopt an isolationist policy. Talk to him, explain in general terms the possible nastiness he could come up against and keep the PC in a public part of the house, in a place where the screen is in view to anyone walking past. If you teach your children the truth about the internet early on, the day will come when you'll feel relaxed enough to put the lock back on the bathroom door, and let them take their iPads in there with them.

But wipe away that cold sweat; this is not that day. For now, all you need to do is play *Minecraft* with your son. It's easy enough to run multiple copies on the same PC, provided it has the horsepower to keep the framerate high enough. You can run each in windowed mode and tile them to fit on the screen. For multiplayer, each copy will need to be logged in to a different account. The real problem here is how to control two games at once. You can't just plug two keyboards in – there's no way to direct the input from each keyboard to a different copy of the game. The only way around this that I can think of is to use the joypad mod (**tinyurl.com/moppd2r**) so you can use the keyboard and mouse for one copy and a USB game controller for the other.
Luis Villazon


Two people can play *Minecraft* on the same PC at the same time.

Tweak Windows 8's Power User menu

Windows 8's Power User menu is a hidden Start menu replacement that puts your tools close to hand. Nick Peers explains.



Microsoft caused a real uproar when it dropped the Start menu from Windows 8. But one mistake it made was failing to advertise it had provided a replacement – of sorts. And all you needed to do was find it.

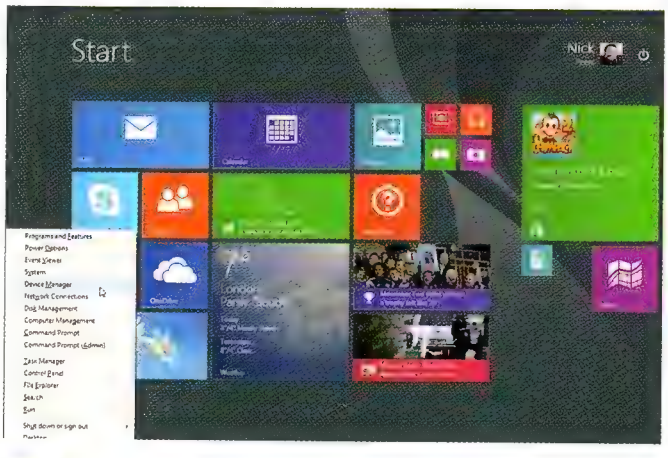
The Power User Menu may not have the functionality of the original Start menu, but that doesn't make it any less useful. Even if you've installed a third-party Start menu replacement, such as ClassicShell's Classic Start Menu, you'll still find the Power User Menu incredibly useful.

As its name implies, it provides convenient shortcuts to key system tools, from the Program and Features Control Panel to the command prompt. In this tutorial, you'll discover how to access the Power User Menu, plus make it even better by adding your own choice of shortcuts to put any program, Control Panel or system tool at your fingertips.

"The Power User Menu may not have the functionality of the original Start menu, but that doesn't make it any less useful."

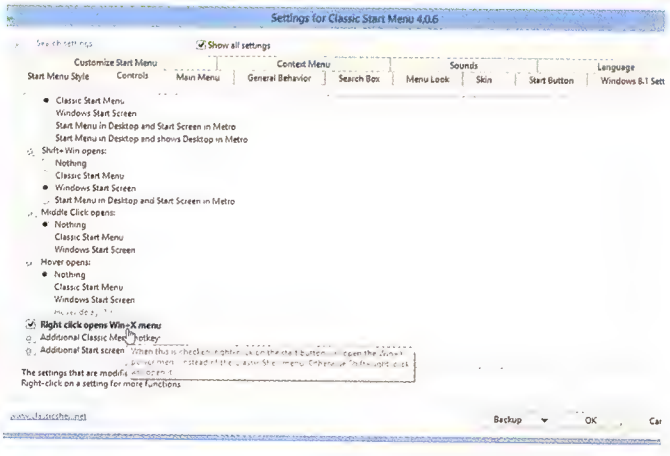
step by step

Use and customise the Power User Menu.



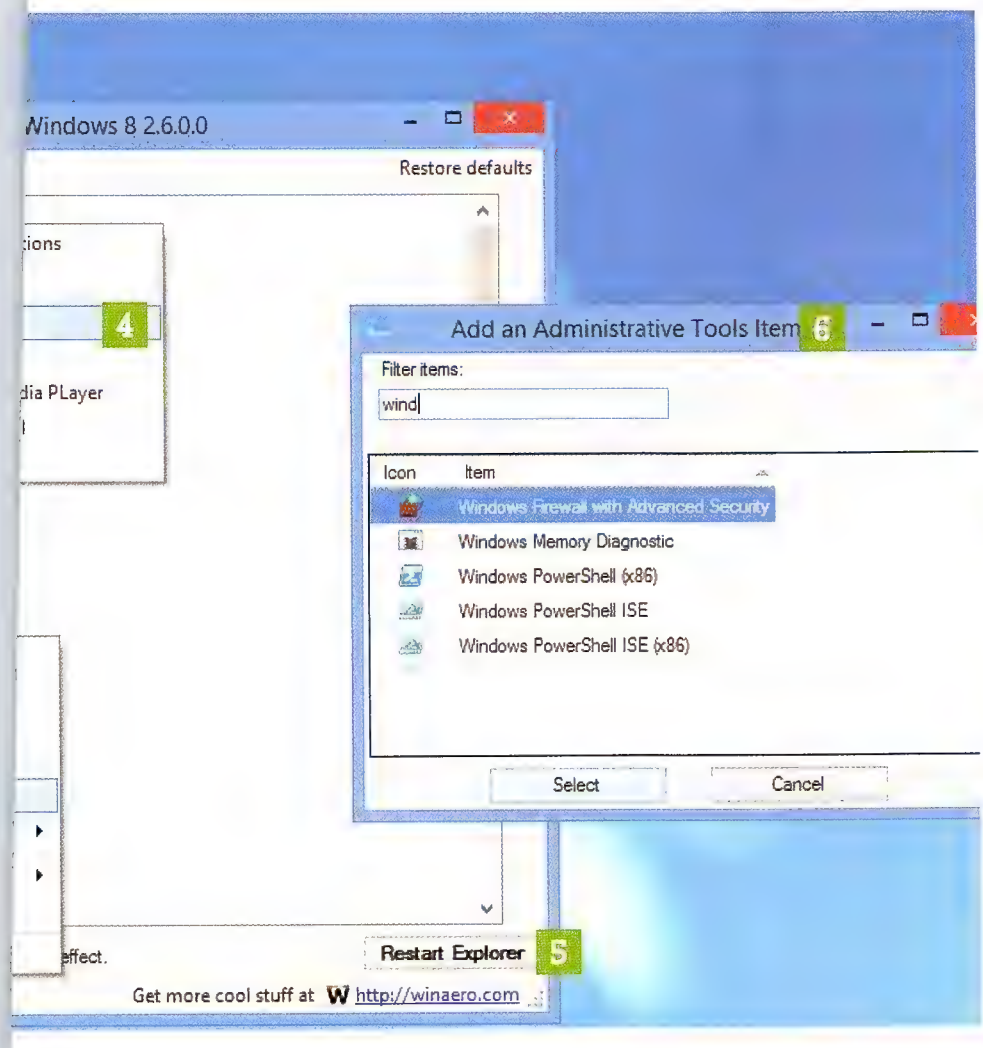
1 ACCESS AND USE

The Power User Menu is accessible from the desktop and the Start screen. If you haven't installed a replacement Start menu then you can access it by right-clicking the Start button to reveal the pop-up menu. You can also access the Power User Menu by holding the Windows key and pressing X. Click a menu item to launch that shortcut; click away from the menu to hide it.



2 RESTORE RIGHT-CLICK IN CLASSICSHELL

If you've installed Classic Start Menu, right-clicking the Start button won't access the Power User Menu. However, you can hold Shift and right-click the Start button to bring it up, or change Classic Start Menu's default behaviour. When you right-click the Start menu, choose Settings. Tick 'Show all settings', go to the Controls tab and tick 'Right click opens Win+X menu'.



1 ADD NEW ENTRIES
The app Win+X Menu Editor makes it easy to add shortcuts to the Power User Menu — first, select a type.

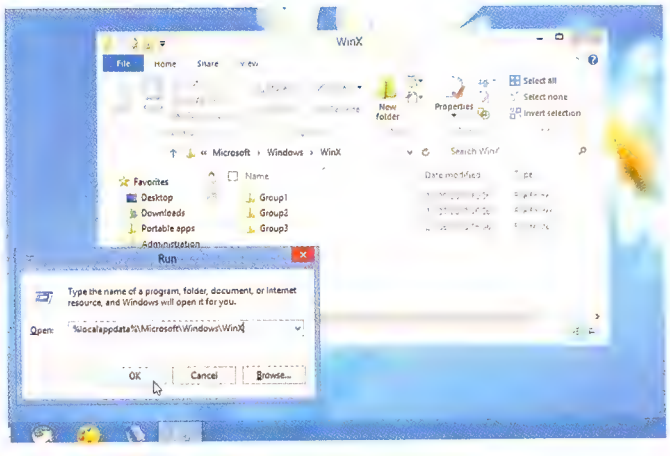
2 VIEW ENTRIES
All existing entries are displayed here in groups and shown in the order they appear on the actual menu.

3 MANAGE ENTRIES
Right-click an entry to reveal options to remove, rename and reorder it. You can also move an item between groups.

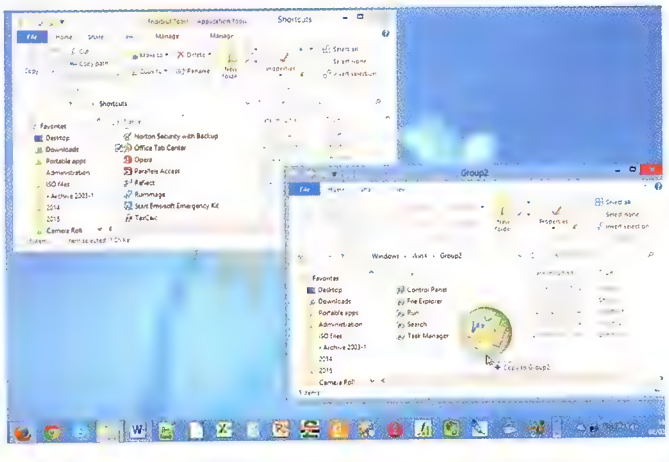
4 PRESETS
A small number of built-in Windows apps as well as the Services management console and shutdown options can be added here.

5 ENABLE CHANGES
Click the Restart Explorer button to see the effects of your changes — once Explorer restarts, press 'Win-X'.

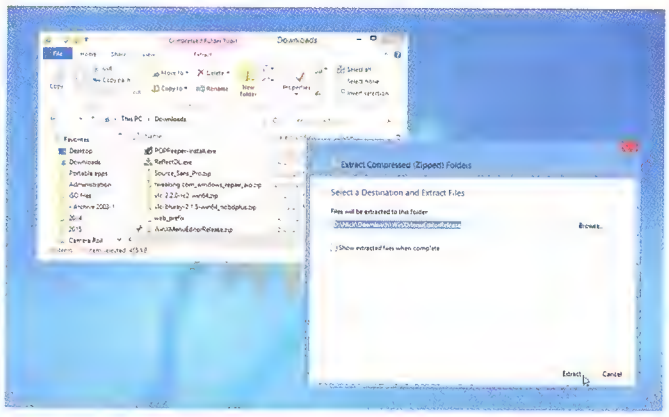
6 ADD MORE ITEMS
Go to 'Control Panel' or 'Administrative Tools' to pick new items from a list — use the filter to find specific entries.



3 MAKE CHANGES MANUALLY
If you want to remove unwanted shortcuts from the menu, press 'Windows-R' to open the Run dialogue box. Type `%localappdata%\Microsoft\Windows\WinX` and press Enter. You'll see three folders: Group1, Group2 and Group3. Each folder contains shortcuts from one section of the menu — Group1 at the bottom, Group2 in the middle, and Group3 at the top.

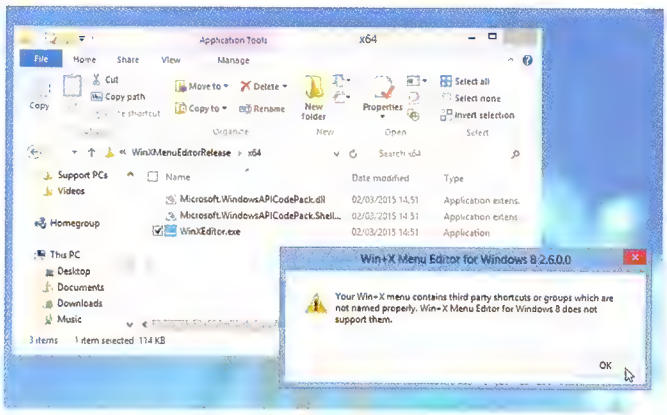


4 DELETE SHORTCUTS
Drag unwanted shortcuts to the Recycle Bin to remove them — the changes will be applied when you log off and back on to your user account, or restart your PC. Sadly, it's not possible to simply add shortcuts to these folders using the manual method — whether you create shortcuts from scratch or drag them into the folder, they simply won't show up in the Power User Menu.



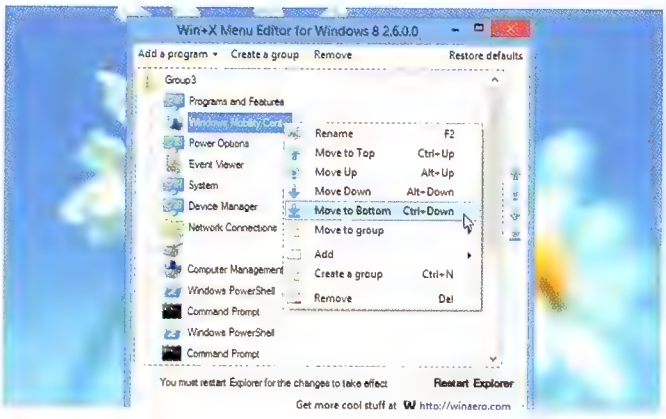
5 USE A THIRD-PARTY TOOL

All is not lost, thanks to a free third-party tool called Win+X Menu Editor. Go to **winaero.com/download.php?view.21** in your web browser, then scroll down and click the grey Download button. Save WinXMenuEditorRelease.zip to your Downloads folder. Right-click the zip file and choose 'Extract All', then click 'Extract' to extract the program folder to your Downloads folder.



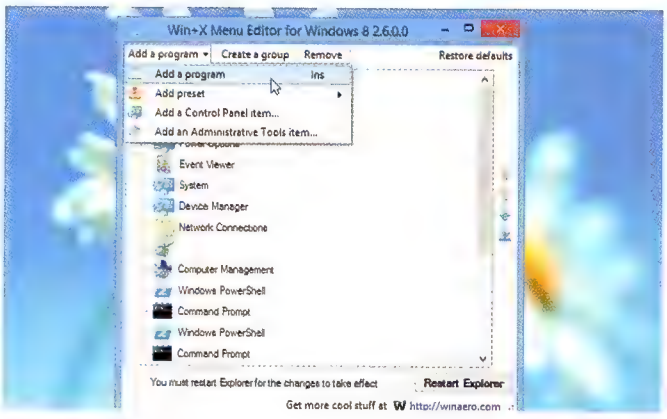
6 LAUNCH PROGRAM

Open the WinXMenuEditorRelease folder (unless you're running the 32-bit version of Windows 8 and double-click WinXEditor) to launch the program. If you've tried to add any shortcuts yourself to these folders, you'll see a warning appear that they're not supported. If this happens, click 'Restore defaults' to remove them when the main window appears.



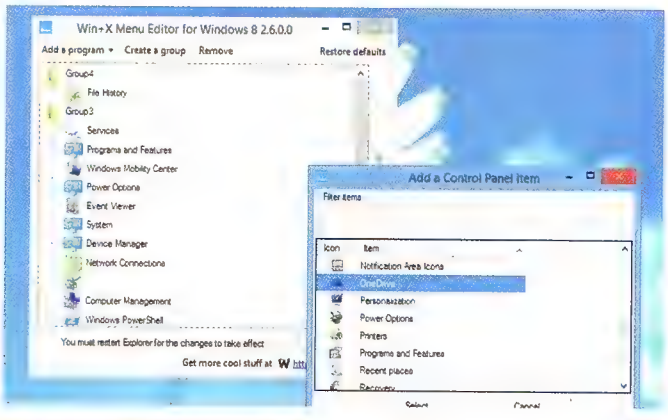
7 MANAGE EXISTING SHORTCUTS

The main program window shows existing shortcuts — right-click one to reveal a list of options. You can, of course, remove it, but there are also options for renaming the entry, plus moving it up and down the list to change the running order. You'll also see an option that allows you to move the shortcut to a new group — this allows you to organise your shortcuts as you wish.



8 ADD YOUR OWN

Win+X Menu Editor also makes it easy to add your own shortcuts. Click the 'Add a program' button to reveal four choices. Select 'Add a Program' again to browse for a program shortcut to add to the group — why not start with a handy shortcut to Win+X Menu Editor itself? Rename your shortcut if necessary, click 'OK' and then right-click it to move it to where you want it to sit.



9 ADD PRESETS

The other three options make it easy to add popular system and administrative tools, as well as shortcuts to individual Control Panel applets. Win+X Menu Editor also allows you to create new groups too — perfect for organising your shortcuts further. Simply click 'Create a group' to add as many as required, then move shortcuts to them. Select a group and click Remove to delete it.

10 THE POWER USER MENU, POWERED UP

Once you're happy with your changes, click the 'Restart Explorer' button to enact them — once Explorer restarts, open the Power User Menu to review what you've done and make further tweaks as required. And there you go — not only have you discovered a handy shortcuts menu, you've learned how to fine-tune it to cover your particular needs too. ■

Create complex coloured shapes with VBA

Helen Bradley shows you how to mimic a Spirograph effect in Visual Basic.

Line art can be created in Visual Basic by rotating a single shape around its centre point. If your shape is partially transparent and if you recolour its edges as you rotate it, you will end up with some interesting artistic effects. This month we'll show you some code for creating and rotating shapes in Excel.

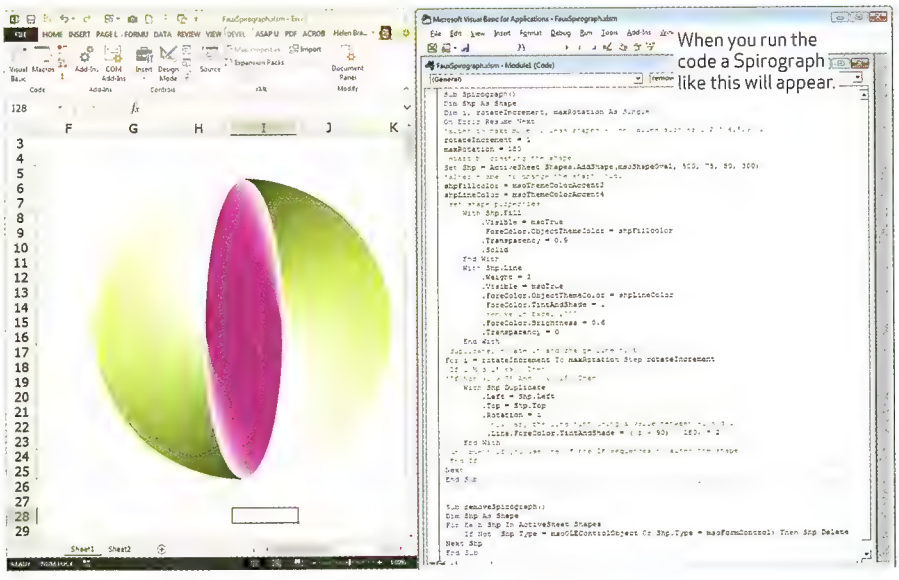
This code works well in Excel 2010 & 2013 and with one minor alteration in Excel 2007. It doesn't won't work in earlier versions because it uses the new colour scheme colours.

This code for Excel will create an oval, fill it with a semi-transparent colour and border, and rotate it around its centre point altering the border tint as it rotates. One thing to note is that, when you duplicate a shape in VBA the copy is moved away from the original so we have added code to ensure each duplicate appears over the top of the original shape. Then, when it is rotated it will rotate around its centre point.

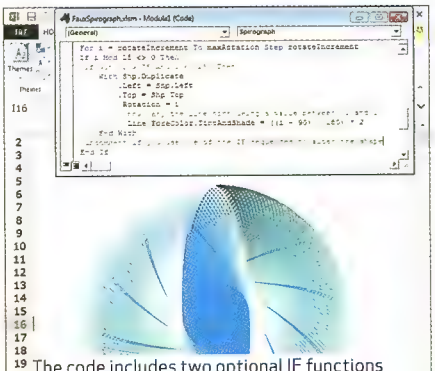
```
  Sub FauxSpirograph()
  Dim shp As Shape
  Dim i, rotateIncrement,
maxRotation As Single
  On Error Resume Next
  rotateIncrement = 1
  maxRotation = 180
  'start by creating the shape
  Set shp = ActiveSheet.Shapes.
AddShape(msoShapeOval, 500,
75, 80, 300)
  shpFillcolor =
msoThemeColorAccent2
  shpLineColor =
msoThemeColorAccent4
      With shp.Fill
          .Visible = msoTrue
          .ForeColor.
ObjectThemeColor = shpFillcolor
          .Transparency = 0.9
          .Solid
      End With
      With shp.Line
          .Weight = 2
          .Visible = msoTrue
          .ForeColor.
ObjectThemeColor =
shpLineColor
    .ForeColor.Brightness = 0.6
'remove in Excel 2007
          .ForeColor.
TintAndShade = 1
          .Transparency = 0
      End With
  For i = rotateIncrement To
maxRotation Step
rotateIncrement
    'If i Mod 15 <> 0 Then
    'If Not (i > 75 And i < 125)
Then
        With shp.Duplicate
            .Left = shp.Left
            .Top = shp.Top
            .Rotation = i
             .Line.ForeColor.
TintAndShade = ((i - 90) / 180)
* 2
        End With
    'uncomment if you use one of
the IF sequences to alter the
shape
    'End If
  Next
  End Sub

  Sub removeSpirograph()
  Dim Shp As Shape
  For Each Shp In ActiveSheet.
Shapes
      If Not (Shp.Type =
msoOLEControlObject Or Shp.Type
= msoFormControl) Then Shp.
Delete
  Next Shp
  End Sub
```

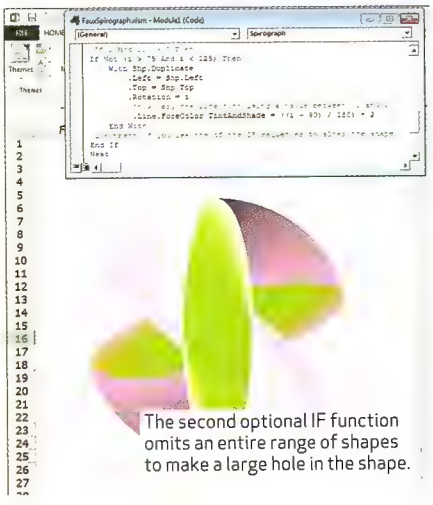
The second macro makes it easy to remove the shapes so you can start over. There are plenty of ways you can adapt and extend this code. You can change the colours of the shape and you can change the rotation increment. Grab the code from **www.apcmag.com/magstuff**.



When you run the code a Spirograph like this will appear.



The code includes two optional IF functions which create different effects. Uncomment one statement and the End If statement to skip creating come of the shapes.



The second optional IF function omits an entire range of shapes to make a large hole in the shape.

Manage iMessage conversations

Alan Stonebridge shows you how to master the advanced features of iOS 8's Messages app.

The Messages app is the most common place to send text and multimedia messages, and it's also packed with advanced features for managing conversations. Many of these features are tied into Apple's iMessage system, so won't work with SMS-only contacts. An iMessage is a type of message that can be sent only between Apple devices, whether they be iPhones, iPads, iPod touches, or Macs – as long as they're online.

Messages saves you resorting to a social network such as Facebook to arrange meeting up with a number of people. That's because iMessage allows everyone who has an Apple device to take part in a group conversation so that the details can be agreed upon together. When plans are less definite, you can share your location – either at that point in time, or with live updates for a few hours if you're likely to roam elsewhere.

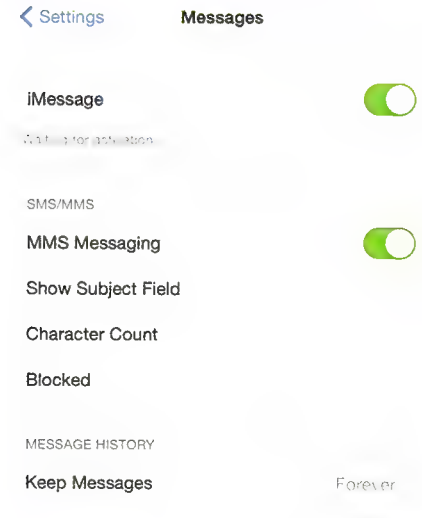
The Messages app also gives you control over how intrusive any conversation can get, regardless of whether it takes place by iMessage or SMS, by suppressing notifications about one while allowing another to still grab your attention.

Also welcome is that Messages – and the Phone and FaceTime apps, too – can block unwanted contact, whether it's from people you know or cold calls from salespeople. Being able to stop the latter is especially welcome these days!

> "Also welcome is that Messages – and the Phone and FaceTime apps, too – can block unwanted contact."

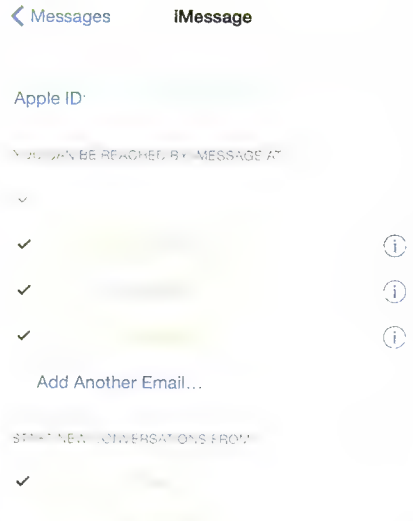
how to

Get started with iMessages.



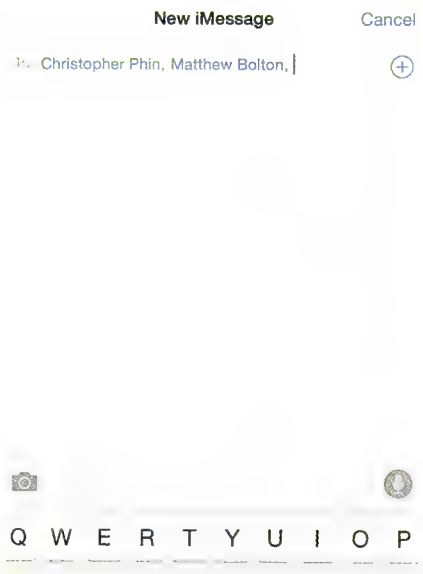
1 SIGN IN TO IMESSAGE

The Messages app can send three kinds of message: SMS, MMS, and iMessage (available only on iOS devices and Macs). You don't have to use Apple's proprietary messaging system, but it offers extras as long as your contacts have Apple devices and also enable the system. In Settings, tap Messages, turn on the iMessage switch, and sign in with your Apple ID.



2 CONTACT OPTIONS

Tap Send & Receive to pick which email addresses linked with your Apple ID can be used by iOS/Mac users to contact you. Tap an address to toggle whether it can be used; those that can are ticked. Your phone number is permanently enabled. You can choose whether your phone number or an email address is used to identify you when you send an iMessage.

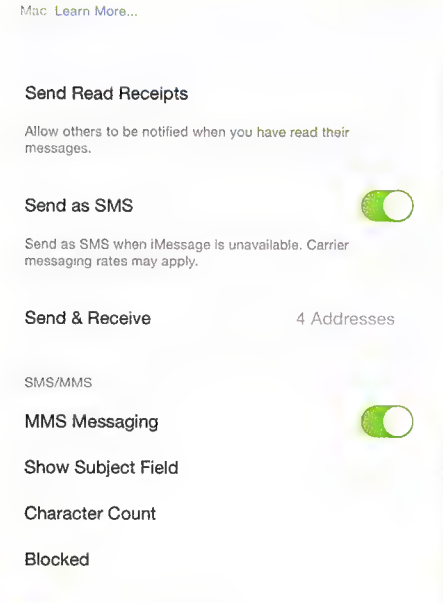


3 WRITE A TEXT MESSAGE

Open Messages and tap the pen and paper icon to write a message. Type the name of someone in Contacts, or tap + to select from that list. A message can have multiple recipients but note that this doesn't just send a copy of the message to each person (like SMS); instead, everyone in the conversation receives the other participants' responses by default.

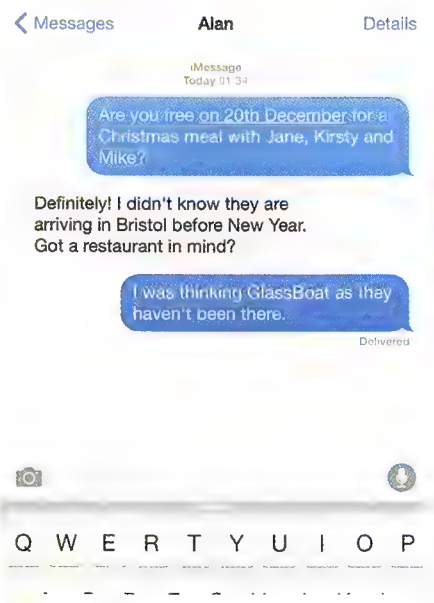
how to

Use advanced iMessage features.



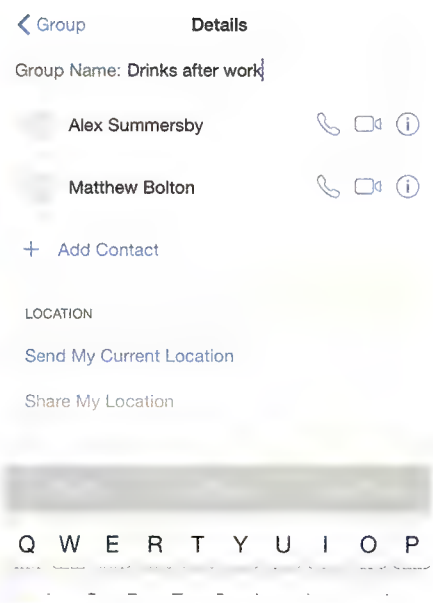
1 SMS OR IMESSAGE

Note the colour of a contact's name after you enter it. When you add a contact, the app confirms with Apple whether that number or address is registered to receive iMessages. If so, it will be blue. If it's green, the message will be sent as an SMS or MMS. Enabling 'Messages > Send as SMS' in Settings ensures the app will fall back on SMS if the iMessages service is unavailable.


Messages
Alan
Details
iMessage
Today 01:34
Are you free on 20th December for a Christmas meal with Jane, Kirsty and Mike?
Definitely! I didn't know they are arriving in Bristol before New Year. Got a restaurant in mind?
I was thinking GlassBoat as they haven't been there.
Delivered
Q W E R T Y U I O P

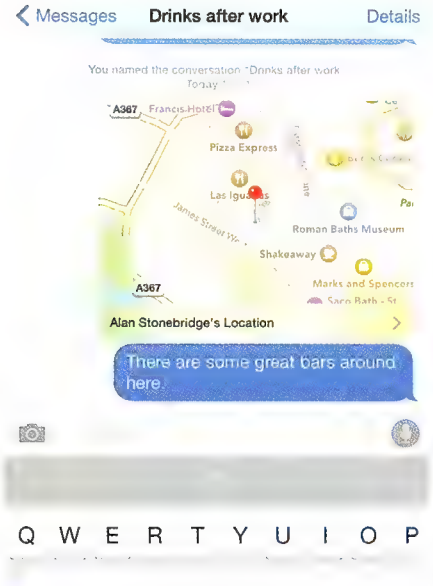
2 READ RECEIPTS

After sending, 'Delivered' should appear below an iMessage's bubble. If the recipient has read receipts enabled, that will change to 'Read'. If you don't want your iPhone to send read receipts, turn off 'Messages > Send Read Receipts' in Settings. Dates appear between bubbles. To see the time messages were sent, swipe left and keep your finger on the screen.



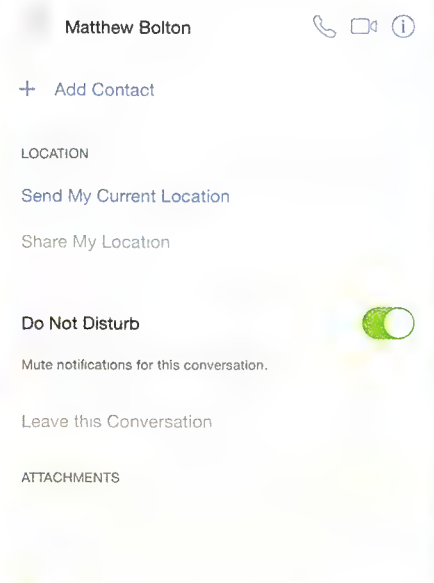
3 GROUP MESSAGING

Group conversations are listed by participants' names; you can assign a label. Tap Details and swipe down to reveal a field above the list of participants, then type a label such as Reunion. Swipe right to left on a name to reveal a Delete button; tap this to stop them receiving contributions. Tap 'Add Contact' to add more people to the conversation.



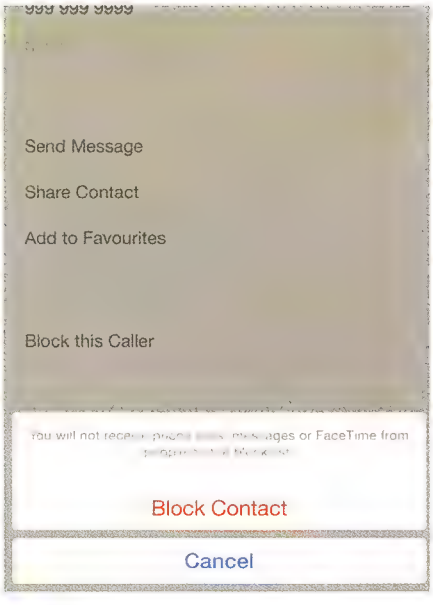
4 SHARE YOUR LOCATION

When meeting someone, tap Details and look under Location. You can share your current location or share your live location for a period of time. When you receive a location, tap the map to view it fullscreen. Choose walking or driving directions and tap Start, or tap Apps to find navigation apps that will help get you there.



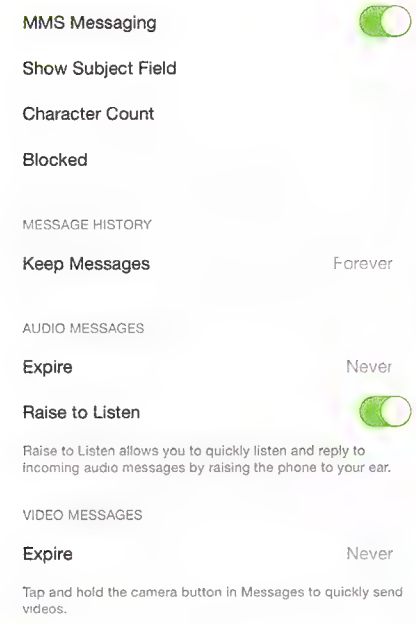
5 MUTE A CONVERSATION

Notifications can become a distraction. Tap Details to turn on Do Not Disturb. This doesn't turn on Do Not Disturb for everything on your iPhone, as the switch of that name in Control Center does — it mutes only this conversation. You'll still receive messages so you can catch up later, and at any time you can turn this switch off again.



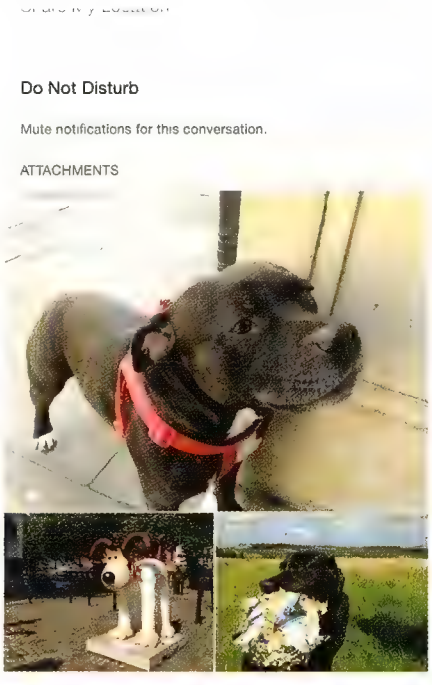
6 BLOCK SENDERS

A sender of unwanted messages can be blocked by tapping the "i" next to their name, then 'Block this Caller'. This also prevents FaceTime and phone calls from that person. You can review everyone you've blocked under 'Settings > Messages > Blocked', and unblock them if necessary by tapping Edit, then the red minus button next to their details.



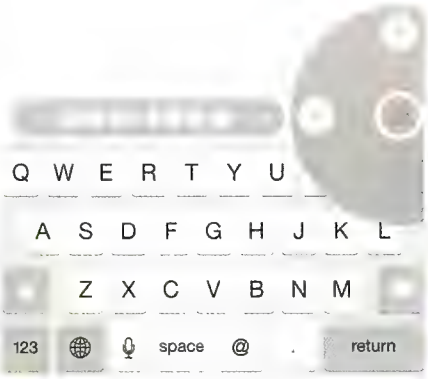
7 SEND A SOUNDBITE

In 'Settings > Messages', if Raise to Listen is enabled, you can record a short audio message by lifting the iPhone to your ear. When you do, the iPhone will emit a short tone to indicate it's recording. Speak, then lower the iPhone when finished. The soundbite will be sent automatically, with no chance to review it. Or another method, gives you the chance to hear it back first…



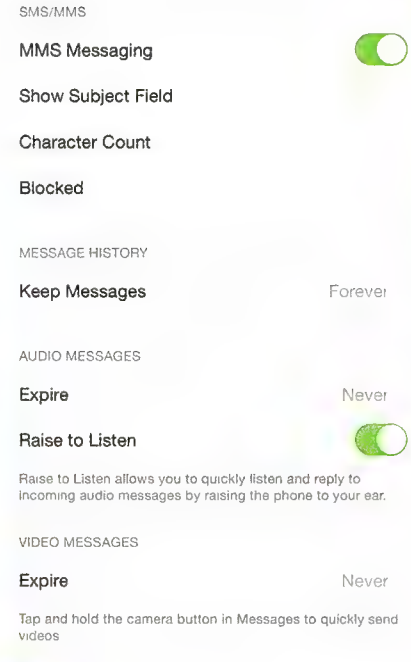
10 REVIEW ATTACHMENTS

Tap Details in a conversation, then scroll down to see photos, videos, sound bites and other attachments sent and received from that contact. Tap and hold one to copy or delete it. Tap More to mark several attachments to save or delete. In 'Settings > Messages', two items labelled Expire can be set to remove audio and video after two minutes or never.



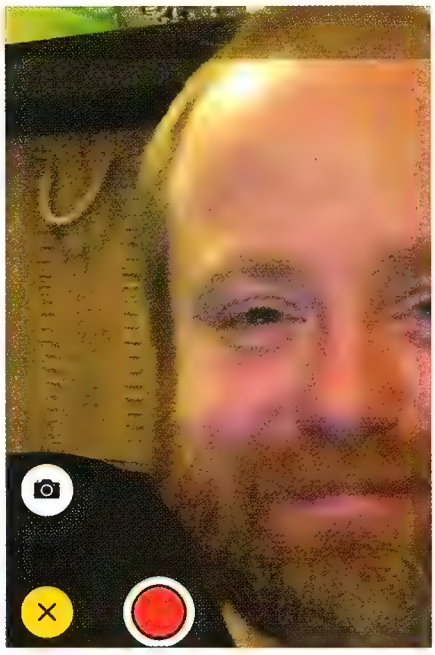
8 AUDIO OPTION

Tap and hold the mic button to the right of the field into which you'd type an iMessage. The app will record as soon as — and for as long as — you hold your finger there. When done, slide your finger up onto the arrow to send the soundbite, or slide left to the cross to delete it. To listen to the soundbite, lift your finger then tap the play button that appears where your finger was.



11 SET EXPIRY DATES

The text in SMS, MMS and iMessages doesn't take up much space, but you may want them deleted after a period of time so you don't have to manage them. Go to Messages settings and tap 'Keep Messages'. Opt to keep messages for 30 days, one year, or forever. Choose either of the first two options, and you'll have to delete messages that are already older than that right away.



9 SEND A PHOTO OR VIDEO

Tap and hold the camera icon (left) to take a photo or video using the front-facing camera. Slide your finger onto the camera icon and lift to send a photo; slide to the red button and hold to record a video. When done, slide onto the arrow to send the video. To send a photo or video you've already taken, just tap the camera, then choose from the options.

Routing to a Mac

Continuity brings a new set of features to iOS 8 and OS X Yosemite, including the ability to make and receive SMS and MMS messages and phone calls from Macs and iPads. It does this by relaying them through your iPhone. All devices — including the iPhone — need to be connected to the same Wi-Fi network, and signed into the same iCloud account. In Contacts on your Mac, open a person's contact card and move the pointer over the number to call them on. Doing this will reveal a phone icon to the right. Click that icon and the Mac's speakers and microphone will be used to make the call. SMS and MMS messages can be sent and received in the Mac's Messages app.

Easy Linux gateway server

Mayank Sharma wants to show you a painless way to get a gateway server up and configured using Zentyal's neatly packed bundles of server tools.

There's no shortage of enterprise-grade open source applications for setting up everything from firewalls and web servers to creating virtual private networks. But setting up and configuring gateway servers requires time and effort, which is where Linux distro Zentyal comes into play. Unlike a regular desktop distro, Zentyal is designed as a one-stop server for small/home office users. You can roll it out as a unified threat manager, office server, communication server and more, thanks to the fact the distro bundles some of the best open source server tools, including OpenLDAP directory server, Bind DNS server, Jabber IM Server, Zarafa groupware, Asterisk VoIP and DansGuardian for content-control management.

It also has a great collection of custom management tools for setting up, controlling and monitoring the various components. Although configuring these network services does require a certain level of familiarity with networking, Zentyal does its best to ease you through the process.

INSTALL ZENTYAL

A good server distro must be easy to deploy, set up and manage, which is why Zentyal releases are based on the Ubuntu Server Long Term Support (LTS) releases. The current stable release, Zentyal 4.0, is based on Ubuntu Server 14.04 LTS. Thanks to its Ubuntu underpinnings, installing it is simple – it's almost completely automated, as the distro is designed to take over the entire disk. However, you can do an Expert installation to manually partition the disk. You can also install the Zentyal server and its components on top of an existing Ubuntu server installation. Head to **www.zentyal.org/server**, download the free community edition and burn the ISO image to a disc. Boot from the disc and select the default installation, unless you have a server with RAID or want to define your partitioning layout – in which case select Expert mode (**see image 1**).

During installation, you'll only be prompted for basic requirements, such as your location and keyboard layout. When prompted to select a network card, choose the one connected to the internet, not your internal network. Also enter the login details of the admin user. The installer will transfer the core modules to your hard disk. When it reboots, the system automatically launches a desktop session with a browser to configure the server.

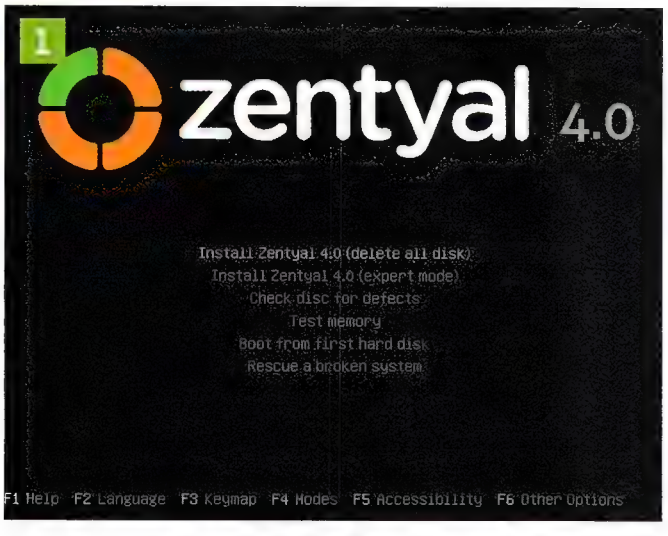
INITIAL CONFIGURATION

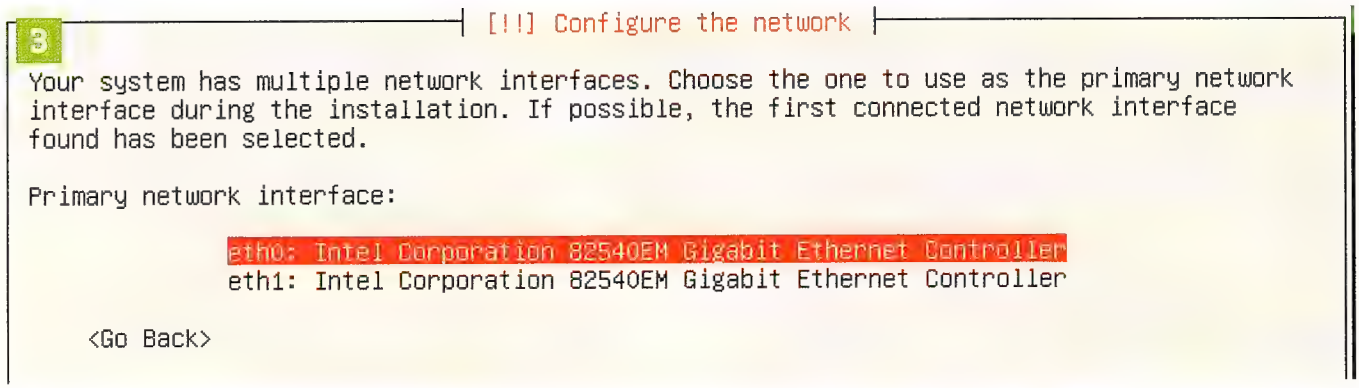
When the distro boots for the first time, it will install some core packages by downloading them from the internet, so make sure it's connected. You'll be logged into Zentyal's sparse desktop, which has an open browser window to Zentyal's web-based administration console. Log into the administration section with the admin details you created during installation (**see image 2**).

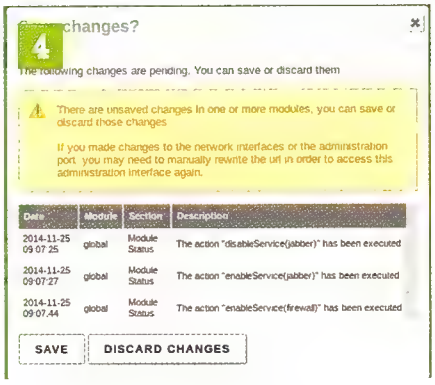
Zentyal will then fire up a configuration wizard. From here you can install various servers and services, such as DHCP Server, Firewall, Domain Controller and Jabber. The server will automatically resolve any dependencies, inform you about the additional components it will install and then fetch them all from the internet. You can skip this step and install them later if you prefer.

One important part of this initial configuration wizard is the networking step. Typically, a Zentyal server will have multiple network interfaces – one pointing to the internet and the other pointed towards the internal intranet. In this step Zentyal shows you all the available network interfaces on your server and asks you to configure them (**see image 3**). You'll first have to mark all available interfaces as either External (connected to the internet) or Internal (connected to the intranet). This will impact several settings, such as the default policies for the firewall, and sets up the default listen interfaces for other modules. Next, you'll get the option to configure these interfaces by manually specifying an IP address or asking the server to use DHCP.

The closing steps in this initial configuration wizard will vary depending on the servers you selected, eg if you select the Domain Controller


1
zentyal 4.0
Install Zentyal 4.0 (delete all disk)
Install Zentyal 4.0 (expert mode)
Check disc for defects
Test memory
Boot from first hard disk
Rescue a broken system
F1 Help F2 Language F3 Keymap F4 Modes F5 Accessibility F6 Other Options


[!!] Configure the network
Your system has multiple network interfaces. Choose the one to use as the primary network interface during the installation. If possible, the first connected network interface found has been selected.
Primary network interface:
eth0: Intel Corporation 82540EM Gigabit Ethernet Controller
eth1: Intel Corporation 82540EM Gigabit Ethernet Controller
<Go Back>


changes?
The following changes are pending. You can save or discard them
There are unsaved changes in one or more modules, you can save or discard those changes
If you made changes to the network interfaces or the administration port, you may need to manually rewrite the url in order to access this administration interface again.
Date
Module
Section
Description
2014-11-25 09:07:25
global
Module Status
The action "disableService(jabber)" has been executed
2014-11-25 09:07:27
global
Module Status
The action "enableService(jabber)" has been executed
2014-11-25 09:07:44
global
Module Status
The action "enableService(firewall)" has been executed
SAVE
DISCARD CHANGES

and File Sharing server, Zentyal will prompt you to select the type of server as well as the domain name of the server. Similarly, if you've selected the Mail and Groupware server you'll be asked to specify the domain name for your mail account. Again, you can skip configuring these servers for now and set them up later.

ACCESSING THE DASHBOARD

When you've finished with the initial configuration wizard, Zentyal will take you to the Dashboard. You can administer and monitor the Zentyal installation from here. In addition to Zentyal's minimalistic LXDE-based desktop environment, you can also access this Dashboard remotely from any computer on the same network as the Zentyal server.

To access it, simply enter the Zentyal server's IP address followed by the port it's running on, so for example https://192.168.2.5:8443. Dashboard can only be accessed through Secure HTTP and runs on port 8443 by default. Also note that since the administration portal is served via the HTTPS protocol, your browser will initially ask you to add a security exception (which you should), as the server lacks a signed certificate.

From the Dashboard you can watch various server components, such as the CPU load, plus the status of all the installed components. From here you can also install any available updates to the underlying core Zentyal distro. The navigation bar on the left of the Dashboard will list the various installed modules, as you add them.

SET UP A JABBER IM SERVER

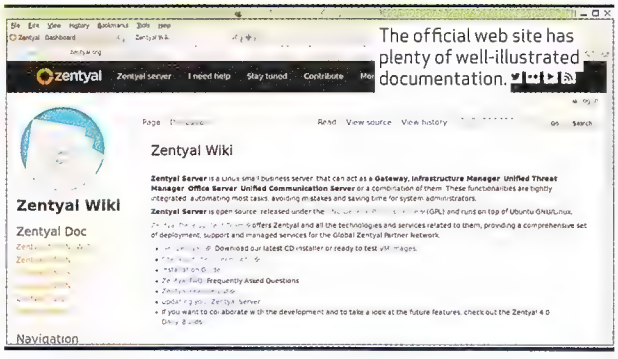
You'll want to keep communications under your control, so to configure an instant messaging server, make sure you've installed the Jabber component. Head to 'Software Management > Zentyal Components' and click the View basic mode link. Select Jabber under the Additional services page, scroll down and click the Install button. Zentyal will show you a list of additional dependency modules that need to be installed. Click Continue to install them all.

Next, head to Module Status, tick the Jabber box to enable the Jabber module and click the Save button to activate it (**see image 4**). To configure the service, go to Jabber in the left-hand menu and set the parameters for the server. Make sure you enter a Jabber domain – you'll then have to pass this on to your users so they can connect to this server (**see image 5**). Feel free to enable/disable the other settings on this page. It's advisable to use the Allow SSL option to make sure the chats are encrypted.

Head to 'Users and Computers > Manage', which displays a list of Groups

Documentation and support

While it isn't too complex to set up, Zentyal offers plenty of options if you need some hand-holding. For starters, there's a dedicated web site where you'll find some extensive, well-illustrated documentation for all the various components of the distro.

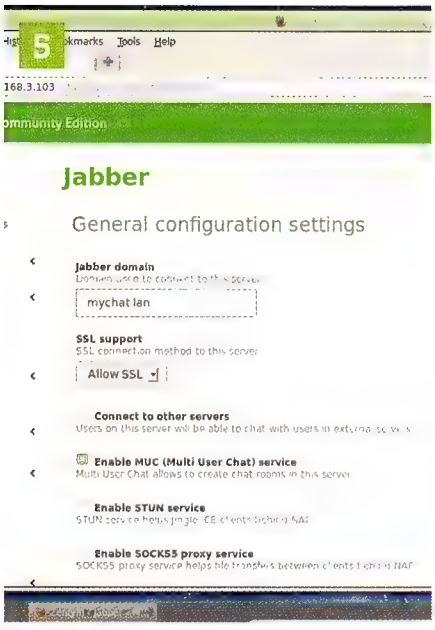


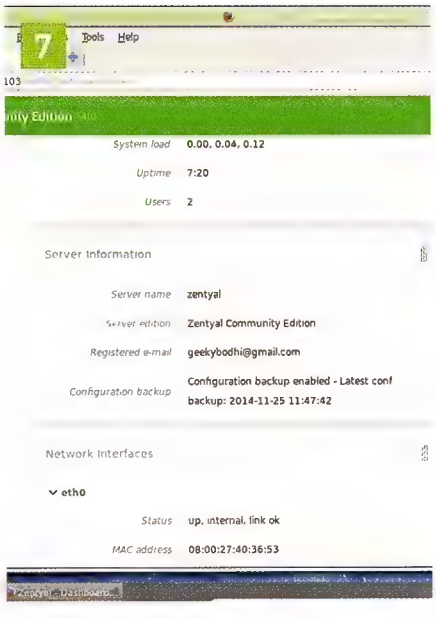
The official web site has plenty of well-illustrated documentation.

The distro also has very active forums where users share their tips and tricks based on the setup of their own networks. It might range from something that'll be of use to only a handful of users — such as a step-by-step guide to resizing Zentyal's default root partition — to something more general, such as connecting a network printer to Zentyal and mapping it automatically to different OS users.

Besides the freely available Community Edition, Zentyal also offers a commercial edition for larger setups that you can test-drive free for 30 days. This edition includes Zentyal's flagship Mail and Directory servers that are compatible with Microsoft's Exchange Server and Active Directory, along with thoroughly vetted software updates, regular detailed reports and alerts from your deployments, plus the ability to remotely monitor and manage the servers. Zentyal also has resellers all over the world.

Zentyal also runs a variety of online and offline courses through its training program to show you the ropes of server management. There are courses for network technicians and for network admins on how to deploy Zentyal most effectively, as well as advanced courses to help troubleshoot deployments and develop new Zentyal modules.





and Users on the Zentyal server. Click the [+] button to add a new user. You can similarly add Groups and associate users with them. Click a username, scroll down to the Modules configuration section and use the pull-down menu to Enable Jabber for this user. You can also tick the box to give this user admin privileges if you want to.

That's all there is to it – but before your users can begin chatting with each other they'll need to configure their Jabber client. Head to **https://xmpp.org** for a list of supported Jabber clients. The exact configuration steps vary for each client. Make sure you select Jabber or XMPP as the protocol (**see image 6**). Then enter your username and password in the appropriate boxes, along with the domain name you specified when you were installing Zentyal.

All users will have to follow the same process. Once they've authenticated with the Jabber server, they can add each other and start communicating. Users can also change their password and other details. The admin user gets some special powers and can see which users are connected to the server, set the message of the day, and broadcast a notice to all connected users.

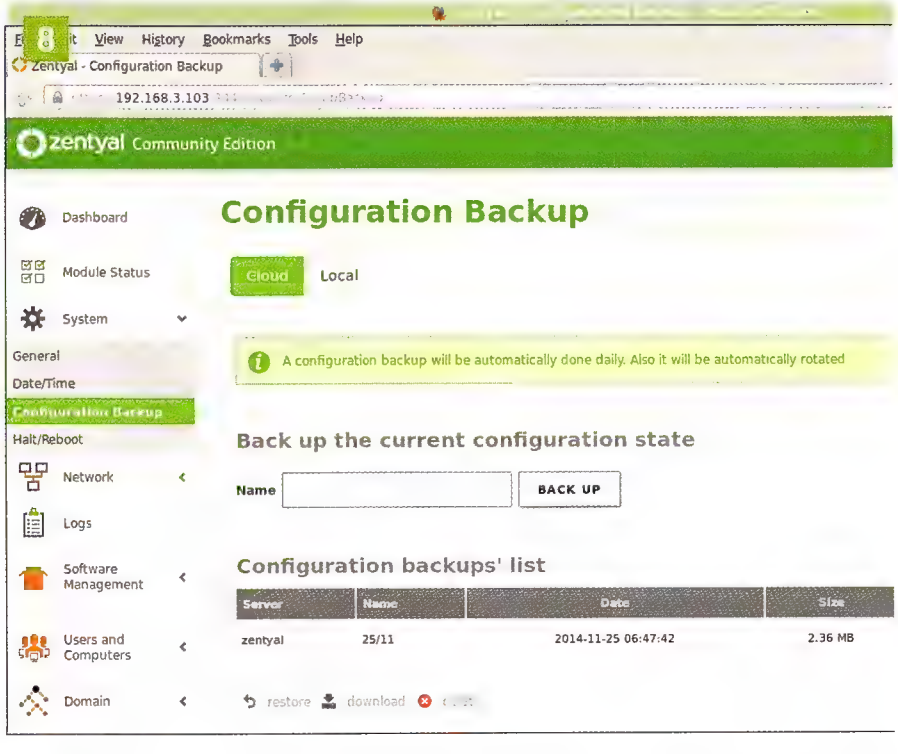
KEEPING YOUR SERVER SHIP-SHAPE

You can monitor the health of the server from the main screen of the Dashboard. From here you can get general information about the server, such as its load average, uptime and number of connected users (**see image 7**). Other sections give you details about the running status of the enabled modules and visualise network traffic. Head to the Logs section to configure and view detailed reports about all the enabled modules.

To share your duties with another user, head to 'System > General' and click the 'Add New' button inside the Administrator Accounts section. On the following page you can define the login credentials of the new admin user. Other settings include changing the hostname and domain name of the server, as well as changing the default port for the dashboard from 8443 to something else.

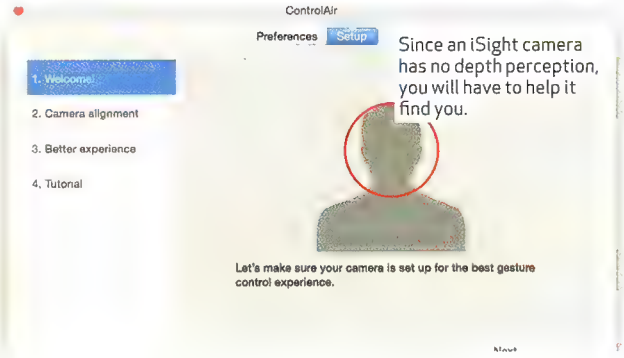
Zentyal can also save your server's configuration. Head to 'System > Configuration Backup', which enables you to save the settings either on Zentyal's cloud server or on your PC (**see image 8**). For cloud backup, enter an email address and a password. Once set up, Zentyal automatically backs up settings daily. To restore them, browse the list of backups and use the Restore button adjacent to the configuration you wish to restore.

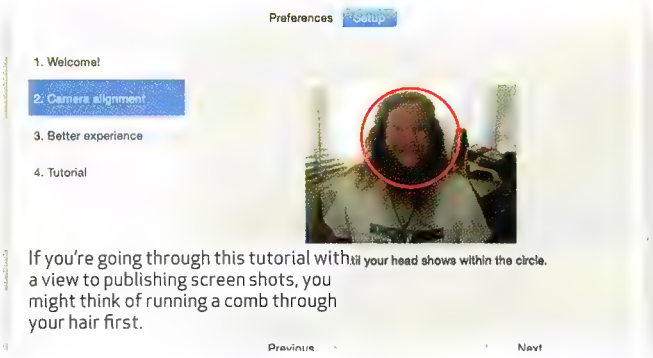
It's also important to keep your system updated. The Dashboard lists the number of system and security updates available under the General Information section. Click the number listed there or head to 'Software Management > System Updates' for more details. Security updates have a red shield in the component name. To update them all, scroll down the page and tick the Update all packages option – and there you have it, your gateway server is up and rolling.



Use gestures to control your Mac

The camera built in to your Mac can act like a basic gesture controller, and Matthew JC. Powell can show you how.


ControlAir
Preferences
Setup
1. Welcome!
2. Camera alignment
3. Better experience
4. Tutorial
Since an iSight camera has no depth perception, you will have to help it find you.
Let's make sure your camera is set up for the best gesture control experience.


Preferences
Setup
1. Welcome!
2. Camera alignment
3. Better experience
4. Tutorial
If you're going through this tutorial with your head shows within the circle.
a view to publishing screen shots, you might think of running a comb through your hair first.
Previous
Next

If you've used one of the current-generation game consoles such as an Xbox One or PlayStation 4, you've probably discovered the sheer joy – and frustration – that comes with using a camera as a controller. The principle is simple: the camera figures out where you are and what position your body and limbs are in, and uses changes in your position to influence specially-written software.

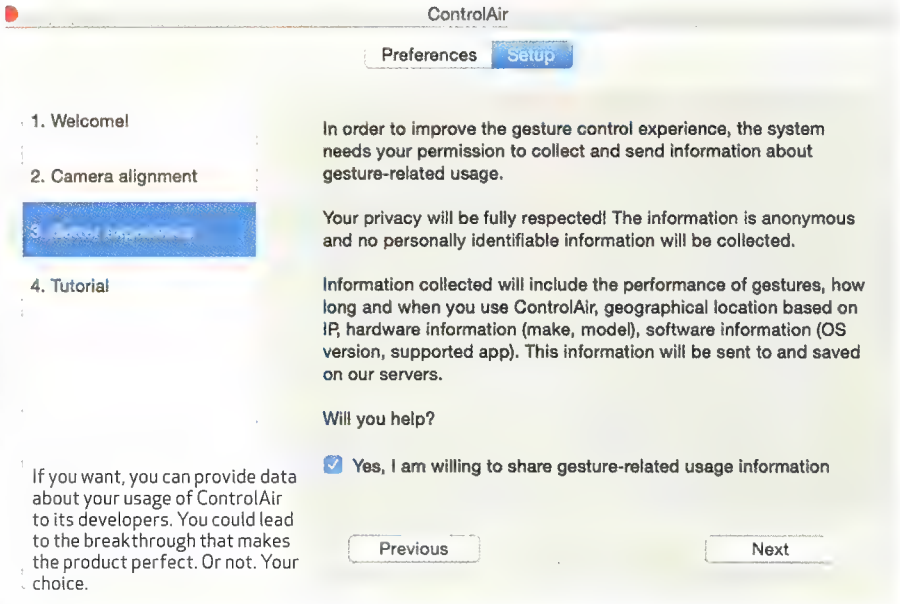
It doesn't always work all that well, of course, for myriad reasons such as lighting, cluttered backgrounds and so forth. But it's fun when it works.

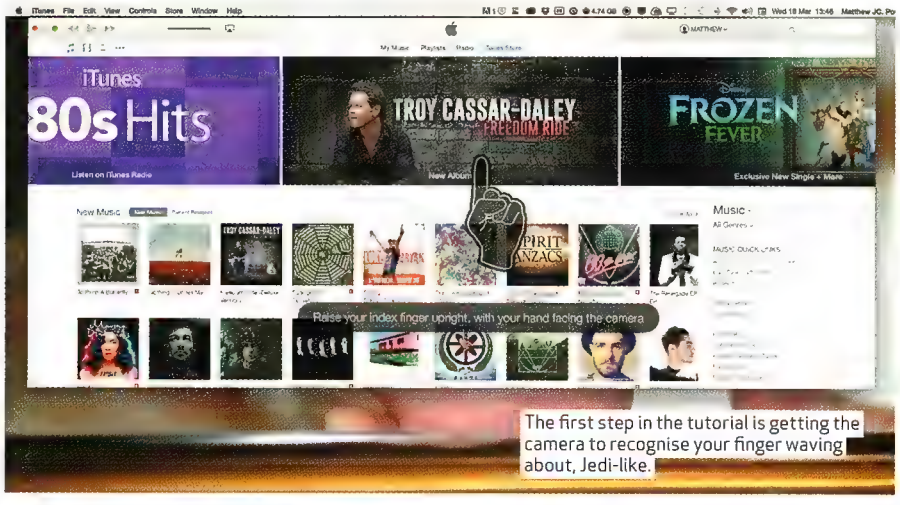
Given the limitations of specially designed cameras and software engineered from the ground up to take advantage of gesture controls, you can imagine the experience with a general-purpose camera and software not written with gestures in mind is even more limited. It is, however, lots of fun.

Thankfully, it's also free. ControlAir, a utility available on the Mac App Store, lets you use the iSight camera built in to your Mac as a gesture controller, so you can use media controls by literally waving a finger in the air.

First, download and install ControlAir from the App Store. When it runs for the first time, it will take you through a brief setup procedure involving calibrating the position of your camera and finding your finger. Unlike the camera controllers for game consoles, your Mac's iSight camera has only one lens, and therefore no real depth perception – so you have to help it find you.

Once it's established where you are and what's background, it's time to set it


ControlAir
Preferences
Setup
1. Welcome!
2. Camera alignment
3. Better experience
4. Tutorial
In order to improve the gesture control experience, the system needs your permission to collect and send information about gesture-related usage.
Your privacy will be fully respected! The information is anonymous and no personally identifiable information will be collected.
Information collected will include the performance of gestures, how long and when you use ControlAir, geographical location based on IP, hardware information (make, model), software information (OS version, supported app). This information will be sent to and saved on our servers.
Will you help?
Yes, I am willing to share gesture-related usage information
If you want, you can provide data about your usage of ControlAir to its developers. You could lead to the breakthrough that makes the product perfect. Or not. Your choice.
Previous
Next



The first step in the tutorial is getting the camera to recognise your finger waving about, Jedi-like.

Speaking of gestures

In the past we've covered how you can use OS X's inbuilt Preview application to sign electronic documents by holding a physical signature on paper in front of the iSight camera. If you happen to have a trackpad (either built in to a laptop or a Magic Trackpad) you can now do the same using gestures.

Yosemite includes a system-wide feature called Markup, which introduces a set of drawing tools to a wide range of applications, including Preview. It also works in Mail and even Stickies.

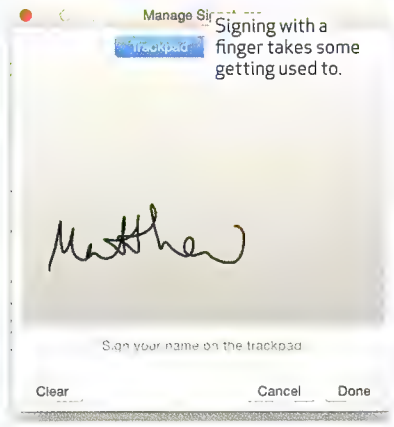
To create a signature using Markup, open a document you wish to sign, such as a PDF, in Preview. Navigate to 'Tools > Annotate > Signature' and if you haven't created a signature before, select Manage Signatures.

A window will open, allowing you to choose between the old (and still way nifty) camera method or the new Trackpad method of signing. Choose the latter, then click on the blue box in the middle to start signing.

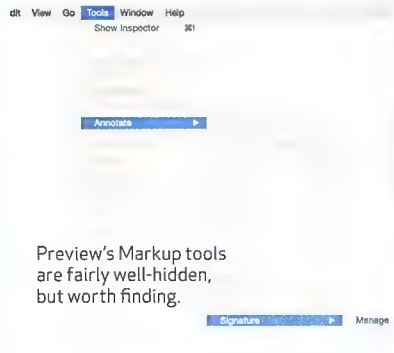
Using a finger to sign your name is a fairly awkward thing, but thankfully any stylus that works with an iPhone or iPad (such as those from Wacom or Kensington) will do nicely. Don't try using an ordinary piece of plastic — it won't work. And for heaven's sake don't use a pen. If you've been signing things on an iPad screen for a while, you may already have the knack.

When you're done, press any key on the keyboard. If you like the signature you've created, click Done and it will be added to your Signature menu. If you don't like it, click Clear and try again.

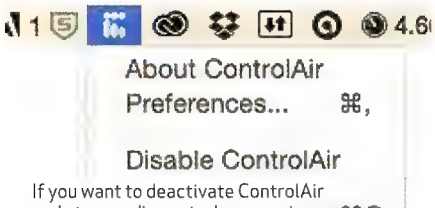
Next time you choose Signature from the menu, you'll have the choice of signatures you've created, and you simply add them to any document like a rubber stamp. Simple and clever.



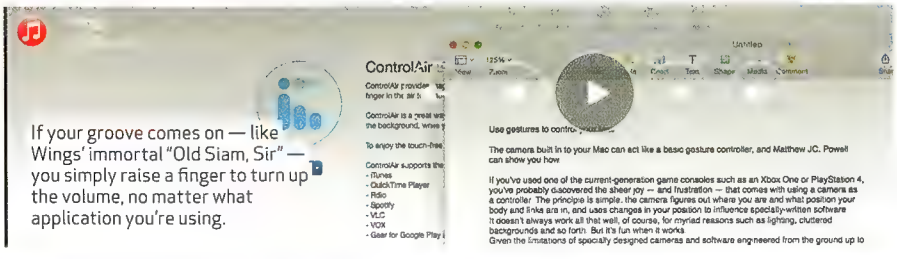
Signing with a finger takes some getting used to.



Preview's Markup tools are fairly well-hidden, but worth finding.



If you want to deactivate ControlAir and stop media controls appearing every time you scratch your head, use the menu in the menu bar.

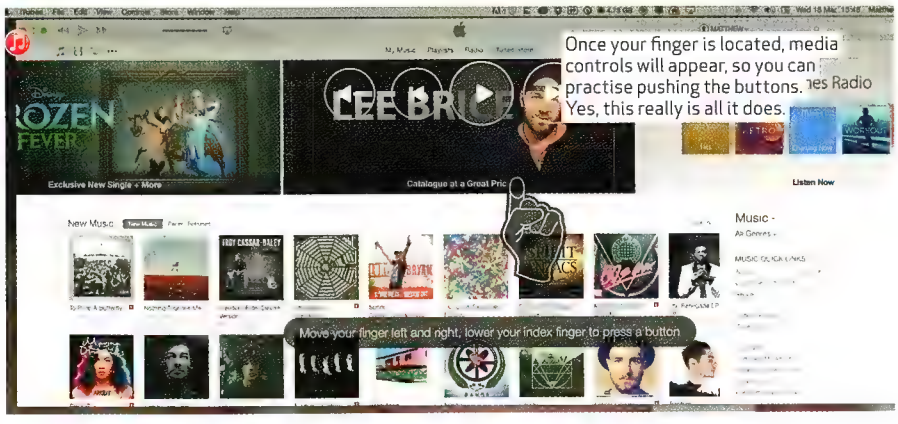


If your groove comes on — like Wings' immortal "Old Siam, Sir" — you simply raise a finger to turn up the volume, no matter what application you're using.

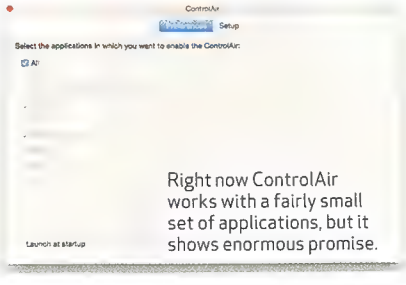
up with a media program. At this stage ControlAir only works with media apps such as iTunes, QuickTime Player and a variety of others. It's also limited to understanding the position of your finger and whether it's pointing up or down — but it's early days yet, and the developers are looking to do much more.

One feature we'd like to see added is support for multiple cameras — increasingly common, especially as many Mac users have multiple monitors, all with built-in cameras. Depth perception would massively increase the range of gestures the application could recognise and therefore the range of commands it could carry out.

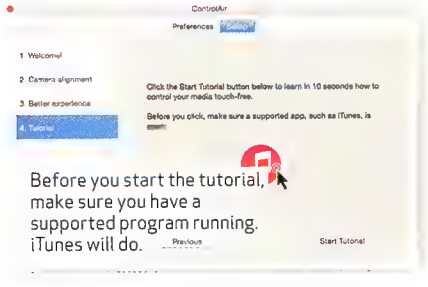
Once you've trained it to recognise what your finger is doing, the application disappears to the background and lets you get on with whatever you were doing. Raise a finger, though, and the on-screen controls appear to allow you to play, pause, skip tracks or change the volume. It's surprisingly useful once you're doing it.



Once your finger is located, media controls will appear, so you can practise pushing the buttons. Yes, this really is all it does.



Right now ControlAir works with a fairly small set of applications, but it shows enormous promise.



Before you start the tutorial, make sure you have a supported program running. iTunes will do.

Pi-powered Tor hotspot

Mayank Sharma configures a Raspberry Pi as an access point that routes all traffic over the anonymous Tor network.

Do you use Tor to prevent big brother from tracking you online? Although it is pretty straightforward to use, it can be quite a hassle to configure Tor on all your internet-enabled devices. You can save yourself a lot of hassle by using a Raspberry Pi as an anonymised wireless access point. The Pi will dole out an IP address and any device that's connected to it will be able to access the internet via the Tor network. To get this project up and running, you'll need a Raspberry Pi along with an SD card with the Raspbian distro. You'll also need an Ethernet cable. Hook one end into the Pi's Ethernet port and the other into your wireless router. This is how the Pi will connect to the internet. You'll also need a USB Wi-Fi adaptor that's compatible with the Raspberry Pi. If you haven't got one yet, check the list of compatible adapters that are known to work on the Pi (*elinux.org/RPi_USB_Wi-Fi_Adapters*).

ACCESS POINT PI

Once you've setup the Pi, you can configure it from a remote machine via SSH. For the rest of the tutorial, we'll assume the IP address of your Pi is 192.168.2.100.

Fire up a terminal that's connected to the same router as the Pi and enter: `ssh pi@192.168.2.100` to connect to it. After authenticating yourself into the Pi, use: `iwconfig` to make sure the wireless adaptor is recognised by the device. Now refresh its package list with: `sudo apt-get update` and install the software that will make it act as an access point with:

```
sudo apt-get install hostapd
isc-dhcp-server
```

When it's installed, it's time to set it up. Begin by editing the /etc/dhcp/dhcpd.conf file that controls the DHCP and automatically assigns IP addresses to all connected devices.

Open it in the nano text editor with

```
sudo nano /etc/dhcp/dhcpd.
conf
```

and comment out the following two lines by adding a # in front of them, so that they read:

```
#option domain-name "example.
org";
#option domain-name-servers
ns1.example.org, ns2.example.
org;
```

In the same file, scroll down and uncomment the word authoritative; by removing the # in front.

Then scroll down to the end of the file and add the following lines:

```
subnet 192.168.12.0 netmask
255.255.255.0 {
range 192.168.12.5
192.168.12.50;
option broadcast-address
192.168.12.255;
option routers 192.168.12.1;
default-lease-time 600;
max-lease-time 7200;
option domain-name "local";
option domain-name-servers
8.8.8.8, 8.8.4.4;
}
```

In these lines we define the IP address of our Pi access point (192.168.12.1), the range of the IP addresses it'll hand out to connected devices (from 192.168.12.5 to 192.168.12.50) as well as the address of the domain name servers (8.8.8.8 and 8.8.4.4). You can change any of these values as per your preference. Save the file (Ctrl-X) once you're done.

SETTING UP A STATIC IP

We'll now edit the /etc/default/isc-dhcp-server to specify the interfaces that our new DHCP server should listen to. Open the file and scroll down to the line that reads INTERFACES="". Insert `wlan0` between the quotes so that it now reads INTERFACES="wlan0", and save the file.

Now we'll setup the wireless adaptor (wlan0) and give it a static IP address. First, deactivate the wireless adaptor with: `sudo ifdown wlan0` command and then open the /etc/network/interfaces file. In the file, comment out every existing entry associated with wlan0, such as:

```
# iface wlan0 inet manual
# wpa-roam /etc/wpa_
supplicant/wpa_supplicant.conf
# iface default inet dhcp
```

Then add the following lines below the line that reads allow-hotplug wlan0 to set the static IP address for the new access point:

```
iface wlan0 inet static
address 192.168.12.1
netmask 255.255.255.0
```

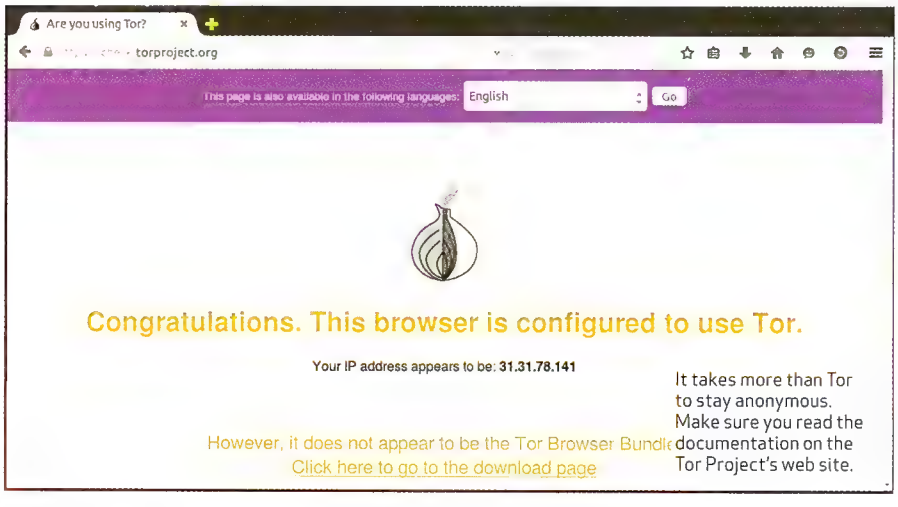
Save the file and activate the interface with

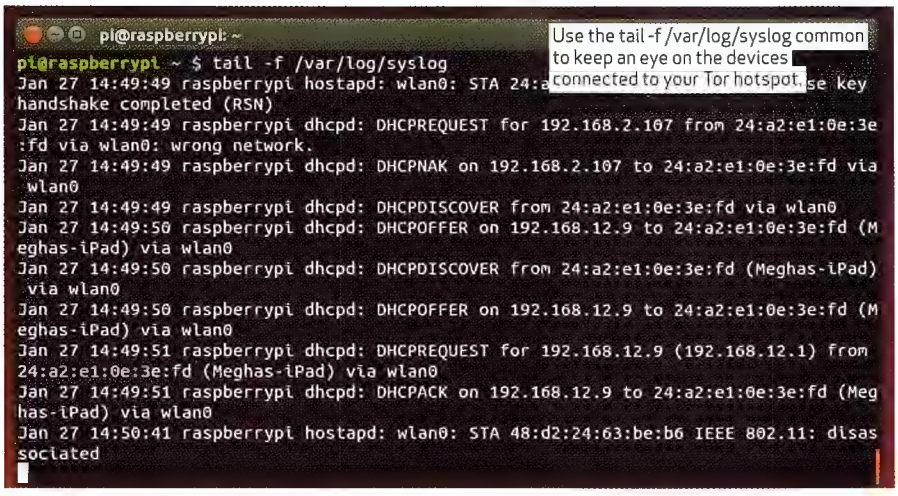
```
sudo ifconfig wlan0
192.168.12.1
```

MAKE YOUR POINT

Now that we've defined the wireless access point it's time to configure it. Create a new file called /etc/hostapd/hostapd.conf with the following contents:

```
interface=wlan0
ssid=TorSpot
```


Are you using Tor?
torproject.org
This page is also available in the following languages:
English
Go
Congratulations. This browser is configured to use Tor.
Your IP address appears to be: 31.31.78.141
However, it does not appear to be the Tor Browser Bundle
Click here to go to the download page
It takes more than Tor to stay anonymous. Make sure you read the documentation on the Tor Project's web site.


pi@raspberrypi: ~
Use the tail -f /var/log/syslog common to keep an eye on the devices connected to your Tor hotspot.
pi@raspberrypi ~ $ tail -f /var/log/syslog
Jan 27 14:49:49 raspberrypi hostapd: wlan0: STA 24:a
se key handshake completed (RSN)
Jan 27 14:49:49 raspberrypi dhcpd: DHCPREQUEST for 192.168.2.107 from 24:a2:e1:0e:3e:fd via wlan0: wrong network.
Jan 27 14:49:49 raspberrypi dhcpd: DHCPNAK on 192.168.2.107 to 24:a2:e1:0e:3e:fd via wlan0
Jan 27 14:49:49 raspberrypi dhcpd: DHCPDISCOVER from 24:a2:e1:0e:3e:fd via wlan0
Jan 27 14:49:50 raspberrypi dhcpd: DHCPOFFER on 192.168.12.9 to 24:a2:e1:0e:3e:fd (Meghas-iPad) via wlan0
Jan 27 14:49:50 raspberrypi dhcpd: DHCPDISCOVER from 24:a2:e1:0e:3e:fd (Meghas-iPad) via wlan0
Jan 27 14:49:50 raspberrypi dhcpd: DHCPOFFER on 192.168.12.9 to 24:a2:e1:0e:3e:fd (Meghas-iPad) via wlan0
Jan 27 14:49:51 raspberrypi dhcpd: DHCPREQUEST for 192.168.12.9 (192.168.12.1) from 24:a2:e1:0e:3e:fd (Meghas-iPad) via wlan0
Jan 27 14:49:51 raspberrypi dhcpd: DHCPACK on 192.168.12.9 to 24:a2:e1:0e:3e:fd (Meghas-iPad) via wlan0
Jan 27 14:50:41 raspberrypi hostapd: wlan0: STA 48:d2:24:63:be:b6 IEEE 802.11: disassociated

```
hw_mode=g
channel=6
macaddr_acl=0
auth_algs=1
ignore_broadcast_ssid=0
wpa=2
wpa_passphrase=$$Your_Passphrase$$
wpa_key_mgmt=WPA-PSK
wpa_pairwise=TKIP
rsn_pairwise=CCMP
```

We've setup a password-protected network called TorSpot. You can specify a different name for the access point by specifying it in the ssid= string. Also change the wpa_passphrase= string to specify a custom password. You'll need to enter this password to authenticate yourself to the Pi's access point.

Next up, we'll tell the Pi where to find this configuration file by pointing to it in the /etc/default/hostapd file. Open the file, find the commented out line that reads #DAEMON_CONF="" and uncomment and edit it to read DAEMON_CONF="/etc/hostapd/hostapd.conf".

NAT SETUP

We now need to set up NAT to allow multiple clients to connect to the Pi's access point and route all their traffic through the single Ethernet IP. Edit the /etc/sysctl.conf file and at the bottom add the following line:

```
net.ipv4.ip_forward=1
```

Save the file and then enter

```
sudo sh -c "echo 1 > /proc/sys/net/ipv4/ip_forward"
```

to activate the forwarding. You'll now have to specify the routing rules that will connect the Ethernet port (eth0) that's connected to the internet and the Wi-Fi access point (wlan0) which is exposed to the devices within your network:

```
sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
sudo iptables -A FORWARD -i eth0 -o wlan0 -m state --state RELATED,ESTABLISHED -j ACCEPT
sudo iptables -A FORWARD -i wlan0 -o eth0 -j ACCEPT
```

By default, these rules will be flushed when you restart the Pi. To make them permanent, first run:

```
sudo sh -c "iptables-save > /etc/iptables.ipv4.nat"
```

Then edit the /etc/network/interfaces file, scroll down to the very end and add

```
up iptables-restore < /etc/iptables.ipv4.nat
```

What this does is loads the rules when the devices are activated on boot.

Your Pi access point is now all set. To test it restart the DHCP server with

```
sudo service isc-dhcp-server restart
```

and manually enable the access point with our configuration with the following command. See *Your Own Hostapd* below if you get an unknown driver error:

```
sudo /usr/sbin/hostapd /etc/hostapd/hostapd.conf
```

Your own hostapd

Sometimes even though a wireless adaptor works out of the box on the Raspberry Pi, it might throw errors when it's asked to serve as an access point. This is especially true of cards that use Realtek chipsets, like the one we've used — MicroNext MN-WD152B — which uses the RTL8192CU chipset. While it works right off the bat for browsing the web, it doesn't work with the hostapd client in Raspbian's repository. It turns out Realtek has its own version of hostapd client which you'll have to use in case you are in the same predicament as us.

To download the file, head to Realtek's download section (**tinyurl.com/kxpbq4o**) and select your chipset from the ones listed. This takes you to a page that lists the drivers for your chipsets. From this page grab the driver for Linux, which will download a compressed zip file with a long-windy name. In our case this was called RTL8188C_8192C_USB_linux_v4.0.2_9000.20130911.zip. We'll just refer to it as driver.zip.

Copy this file across to the Raspberry Pi using scp using something like:

```
scp driver.zip  pi@192.168.2.100:/home/pi
```

This copies the file to the Pi's home directory. Now extract the file with: `unzip driver.zip` and `cd` into the wpa_supplicant_hostapd directory.

It'll list several compressed tarballs. Use the `tar zxvf` command to extract the file beginning with wpa_supplicant_hostapd. Now `cd` into the hostapd directory under the extract directory. This directory has a file named Makefile. Open it in a text editor and replace the

```
CFLAGS = -MMD -O2 -Wall -g
```

line towards the top of the file with

```
CFLAGS=-MMD -Os -Wall -g
```

Save the file and enter make to compile the hostapd client. It'll take quite some time and when it's complete it'll replace the hostapd binary in this directory.

Before using this new version, move out the old version with:

```
sudo mv /usr/sbin/hostapd /usr/sbin/hostapd.orig
```

Then copy over the newly compiled version with the following:

```
sudo cp hostapd /usr/sbin/
```

And give it the right permissions with:

```
sudo chmod 755 /usr/sbin/hostapd
```

You should now be able to get your access point online without any issues.

```
pi@raspberrypi ~
Setting up torsocks (1.2-3) ...
Setting up tor-geoipdb (0.2.4.24-1) ...
pi@raspberrypi ~ $ sudo nano /etc/tor/torrc
pi@raspberrypi ~ $ sudo iptables -F
pi@raspberrypi ~ $ sudo iptables -t nat -F
pi@raspberrypi ~ $ sudo iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 22 -j REDIRECT --to-ports 22
pi@raspberrypi ~ $ sudo iptables -t nat -A PREROUTING -i wlan0 -p udp --dport 53 -j REDIRECT --to-ports 53
pi@raspberrypi ~ $ sudo iptables -t nat -A PREROUTING -i wlan0 -p tcp --syn -j REDIRECT --to-ports 9040
pi@raspberrypi ~ $ sudo iptables -t nat -L
Chain PREROUTING (policy ACCEPT)
target     prot opt source               destination
REDIRECT   tcp  --  anywhere             anywhere            tcp dpt:ssh redir ports 22
REDIRECT   udp  --  anywhere             anywhere            udp dpt:domain redir ports 53
REDIRECT   tcp  --  anywhere             anywhere            tcpflags: FIN,SYN,RST,ACK/SYN redir ports 9040

Chain INPUT (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination

Chain POSTROUTING (policy ACCEPT)
target     prot opt source               destination
pi@raspberrypi ~ $
```

Verify the traffic redirection rules with the sudo iptables -t nat -L command.

If everything goes well, the wireless access point (TorSpot) is listed in the list of available Wi-Fi hotspots. You can connect to it from another computer or a smartphone and authenticate using the password you specified in the hostapd.conf file. When connected, you should be able to browse the internet normally.

Once you have tested the new access point, let's cement the settings so that they are activated as soon as the Pi boots up. Start the hostapd and DHCP services with: `sudo service hostapd start` and `sudo service isc-dhcp-server start` commands and then update the init scripts with: `sudo update-rc.d hostapd enable` and `sudo update-rc.d isc-dhcp-server enable`

Now restart the Pi with

```
sudo shutdown -r now
```

When the Pi is back up again, you'll be able to connect to the new access point and browse normally.

TORIFY ACCESS

Your Raspberry Pi is now fully functional as a wireless hotspot. However, the data is still not anonymised. So let's add Tor to the mix.

SSH back into the Pi and install Tor with

```
sudo apt-get install tor
```

When it's installed, edit Tor's config file /etc/tor/torrc and add the following at the top:

```
Log notice file /var/log/tor/notices.log
VirtualAddrNetwork 10.192.0.0/10
AutomapHostsSuffixes .onion,.exit
AutomapHostsOnResolve 1
TransPort 9040
TransListenAddress 192.168.12.1
DNSPort 53
DNSListenAddress 192.168.12.1
```

These settings inform Tor about the IP address of our access point and asks that it anonymises any traffic that flows over it. Next up, we'll change the routing tables so that connections via the Wi-Fi adaptor (wlan0) are routed through Tor. First, flush the existing redirection and NAT rules with the `sudo iptables -F` command go on to `sudo iptables -t nat -F` command. Since, we'll still want to be able to SSH into the Pi, we'll add an exception for SSH's Port 22 with:

```
sudo iptables -t nat -A PREROUTING -i wlan0 -p tcp --dport 22 -j REDIRECT --to-ports 22
```

We'll now add two rules. The first is a passthrough rule for DNS lookups and the second directs all TCP traffic to Tor's port 9040:

```
sudo iptables -t nat -A PREROUTING -i wlan0 -p udp --dport 53 -j REDIRECT --to-ports 53
sudo iptables -t nat -A PREROUTING -i wlan0 -p tcp --syn -j REDIRECT --to-ports 9040
```

Like before, these rules won't be carried on to the next session. To load them on reboot, all you have to do is save them to the NAT save file like before with: `sudo sh -c "iptables-save > /etc/iptables.ipv4.nat"`

In the previous section, we've already configured the /etc/network/interfaces file to load the contents of this file when the interfaces are activated.

You can now enable the Tor service with `sudo service tor start` and update the relevant boot scripts with `sudo update-rc.d tor enable`.

That's it. Now restart the Pi. When it's back up again, you'll be able to connect to the Pi hotspot, TorSpot, as before. However, unlike as before all your traffic will now be routed through the Tor network.

You can verify that this is happening by heading to **https://torproject.org** from any device that's connected to TorSpot. The page will also list your IP address which will not be that of your ISP. Visit this page from another device connected to TorSpot and it'll show a different address. Congratulations, you can now anonymously browse the web on all your devices!

Tor-in-a-box options

If you find this tutorial too cumbersome, or want to set up something for a non-technical friend or relative, there are several ready-made hardware solutions that can anonymise all their web traffic in a similar fashion.

There's the OnionPi Pack from AdaFruit (**www.adafruit.com/products/1410**) which includes a Raspberry Pi B+ and a compatible USB Wi-Fi adaptor along with a case for the Pi, cables, SD card and everything else you need to setup your Torrified Wi-Fi hitspot. The bundle costs US$80. However, you'll still have to follow the instructions and set it up yourself.

If you'd rather have something more plug and play, there's the SafePlug from the guys who bought us PogoPlug. It's a US$49 device that plugs into your wireless router and once activated routes all traffic over the Tor network. A neater and smaller alternative is the Anonabox (**www.anonabox.com**). It initially launched on Kickstarter but after its funding was suspended it relaunched on Indiegogo. Here it was listed at US$99 and surpassed its funding target in early January 2015 and will begin shipping in February 2015. Anonabox is a router that you can directly connect to via Wi-Fi or Ethernet.

Another router-based option is Portal which stands for Personal Onion Router To Assure Liberty. The project produces a pre-built software image for several TP-Link routers. You can simply flash the Portal firmware image onto these router following the instructions on the project's web site (**github.com/grugq/portal**).

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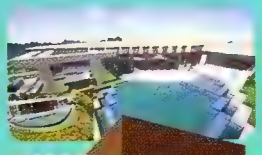

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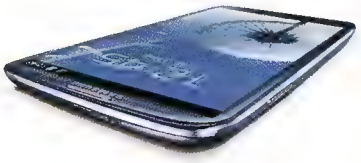
Upgrading to Lollipop (unofficially)



Still waiting for a Lollipop update? Darren Yates looks into choosing an unofficial ROM for your mobile device.

Arguably the greatest frustration with Android is the whole 'where's my update?' run-around that seems to happen every time Google releases another sweet-flavoured version of our favourite mobile OS. Google may release a new flavour, but it's still up to the device manufacturers to validate it for existing devices. The problem is, few vendors seem to want the hassle for devices sold more than 18 months ago. It's something we saw start with Froyo/2.2 and notice pick up when Ice Cream Sandwich/4.0 arrived (particularly in trying to find a port for my HTC Desire smartphone!).

However, with news that Google is no longer patching WebView security flaws in pre-KitKat/4.4 releases (**tinyurl.com/o2d5hho**), updating is no longer just about having the latest OS.

UNOFFICIAL LOLLIPOP

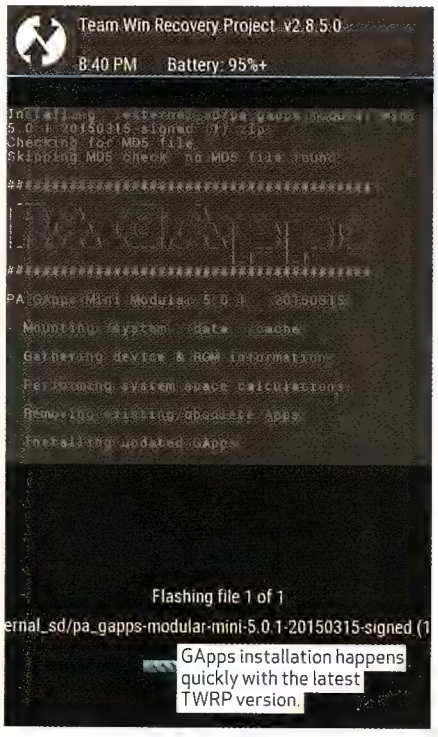
Samsung's Galaxy S3 smartphone was one of the first mega-successes for Android, a phone that, according to reports, sold more than a staggering 50 million units globally following its June 2012 release. Since it first launched with ICS/4.0.4, it's received official ROM support up to Jelly Bean/4.3, but nothing since (at least not in Australia). Obviously, it's not the first, nor will it be the last phone to eventually fall off the update radar. But annoyingly, there have been rumours of official KitKat updates for the Galaxy S3 over much of the last year, none of which had come to fruition locally by time of writing (mid-March 2015).

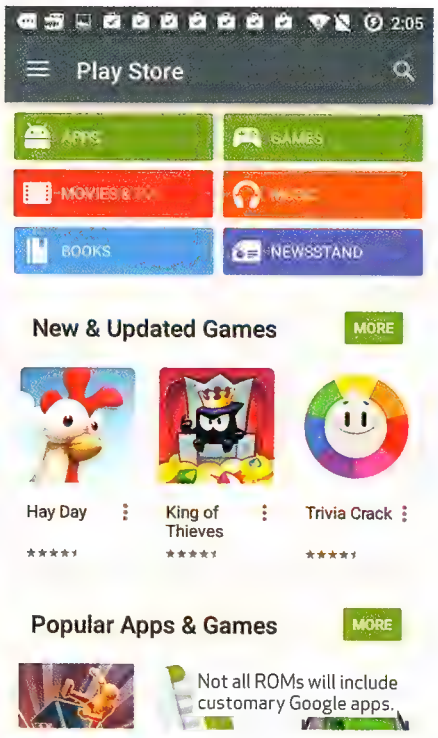
But despite no official offerings from Samsung, the Android community hasn't given up on the idea of running Lollipop on the S3. In recent weeks, new unofficial Lollipop/5.0.2 ROMs have begun appearing, with Resurrection Remix, Temasek and JustArchi's Weekly 8 ROMs amongst the most popular of this new breed.

But it's worth asking just what can you expect from an unofficial ROM – among other things, do you get full device functionality, is anything missing and is it stable? And does the camera work?

WARNING

Gaining root-access on any Android device and flashing it with new firmware will void your warranty. Flashing the wrong firmware to your device will likely brick it, rendering it inoperable. Due to the nature of new Lollipop security additions, attempting to gain root-access may also result in boot-loop issues. Make sure you perform a full Nandroid backup of your device before you begin — and know how to restore that backup in the event that something goes wrong. While we performed the tasks outlined in this feature on a Samsung Galaxy S3 phone without issue, you proceed at your own risk and assume all responsibility for any device failure.


Team Win Recovery Project v2.8.5.0
8:40 PM Battery: 95%+
Flashing file 1 of 1
GApps installation happens quickly with the latest TWRP version.



HUGE INTEREST

There's no doubting the huge interest in Lollipop support, not just for the Galaxy S3, but for a wide range of recent-generation devices, whose owners are hanging on for any word of an update. But in the roughly three months or so since the first of JustArchi's Weekly ROMs for the Galaxy S3 appeared (**tinyurl.com/kbwh4u8**), more than 1,000 pages of forum discussion have been generated on the XDA Developers web site on this one ROM alone – with more on the way.

The majority of new Lollipop ROMs for the Galaxy S3 are based on CM12 source code CyanogenMod has yet to officially announce at time of writing, making them 'unofficial' unofficial ROMs, if you like. Although, just why CyanogenMod hasn't officially announced an S3 Lollipop ROM appears to come down to a lack of someone putting up their hand to be 'device maintainer', given recent forum comments.

But whichever option you choose, be aware that it's unlikely every ROM will be perfect. Most ROMs have little

Lollipop gives the Galaxy S3 a small bump in application speed.

niggles, so check its 'known issues' list before deciding on one.

INSTALLING LOLLIPOP USING TWRP

Like any other custom ROM, installing Lollipop on a Galaxy S3 (or any other device for that matter) requires a device with root-access. We've covered this before, so we won't go over the basics now. If you still haven't rooted your device yet, you can read our latest how-to at **apcmag.com/how-to-root-your-android-phone.htm**.

Remember – installing a fresh ROM requires wiping the contents of your device, so make sure you've backed up everything you want to keep before you begin. A combination of Nandroid and Titanium Backup is a good place to start, but research the best backup options for your particular device, prior to doing anything.

Once you're ready, the next task is to ensure you install the latest version of a custom recovery ROM. In the past, ClockworkMod Recovery (CWMR) has been our preferred option, however, from our experience this time around, we recommend using the latest version of TeamWin Recovery Project (TWRP, we used version 2.8.5.0) instead.

When it comes to choosing a Lollipop ROM, the key is to ensure you choose one that's designed for your specific device. We're using a 3G-version Samsung Galaxy S3 for this masterclass, known as the GT-I9300 (although, it also went under the 'GT-I9300T' moniker in Australia). Grab the appropriate ROM image zip file and copy it to your device storage.

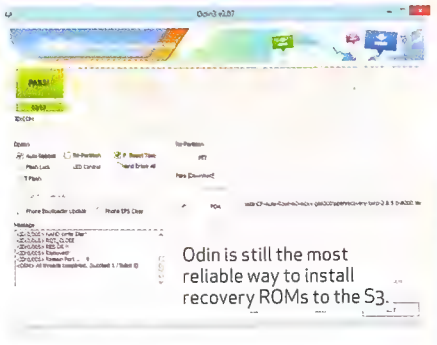
If you're using the latest TWRP, boot into recovery mode ('Power-Home-Volume Up' buttons) and when TWRP launches, press Install, select the ROM image zip and swipe the 'Swipe to Confirm Flash' control to begin the process. Once you get the success screen, you need to wipe the Dalvik cache to ensure the new ROM will launch, then reboot.

PA GAPPS PACKAGE COMPARISONS

	Application Name	gapps-config Key Word	Pico Modular Gapps	Nano Modular Gapps	Micro Modular Gapps	Mini Modular Gapps	Full Modular Gapps	Stock Google Gapps
NEXUS FACTORY IMAGE APPLICATIONS	Google System Base [1]		●	●	●	●	●	●
	Off-line Speech Files [2]	Speech		●	●	●	●	●
	FaceUnlock	FaceUnlock			●	●	●	●
	SunBeam Live Wallpaper	SunBeam					●	●
	Google Exchange Services [4]	ExchangeGoogle				●	●	●
	Google Calendar Sync [3]	CalSync	●	●	●	●	●	●
	Google Play Store [1]		●	●	●	●	●	●
	Google Play services [1]		●	●	●	●	●	●
GOOGLE PLAY STORE APPLICATIONS	Google (Search)	Search		●	●	●	●	●
	Google Calendar [4]	CalendarGoogle			●	●	●	●
	Google Now Launcher	GoogleNow			●	●	●	●
	Google Text-to-Speech	GoogleTTS			●	●	●	●
	Gmail	Gmail			●	●	●	●
	Google+	GooglePlus				●	●	●
	Hangouts	Hangouts				●	●	●
	Maps	Maps				●	●	●
	Street View on Google Maps	Street				●	●	●
	YouTube	YouTube				●	●	●
	Chrome Browser	Chrome					●	●
	Cloud Print	CloudPrint					●	●
	Google Docs	Docs					●	●
	Google Drive	Drive					●	●
	Google Earth	Earth					●	●
	Google Keep	Keep					●	●
	Google News & Weather	NewsWidget					●	●
	Google Play Books	Books					●	●
	Google Play Games	PlayGames					●	●
	Google Play Movies & TV	Movies					●	●
	Google Play Music	Music					●	●
	Google Play Newsstand	Newsstand					●	●
	Google Talkback	TalkBack					●	●
	Google Wallet	Wallet					●	●
	Messenger	Messenger					●	●
	Sound Search for Google Play	Ears					●	●
	Google Camera [4]	CameraGoogle						●
	Google Keyboard [4]	KeyboardGoogle						●
	Google Sheets	Sheets						●
	Google Slides	Slides						●

Google Apps often are not included, but can be installed separately.
Source: xda-developers.com.

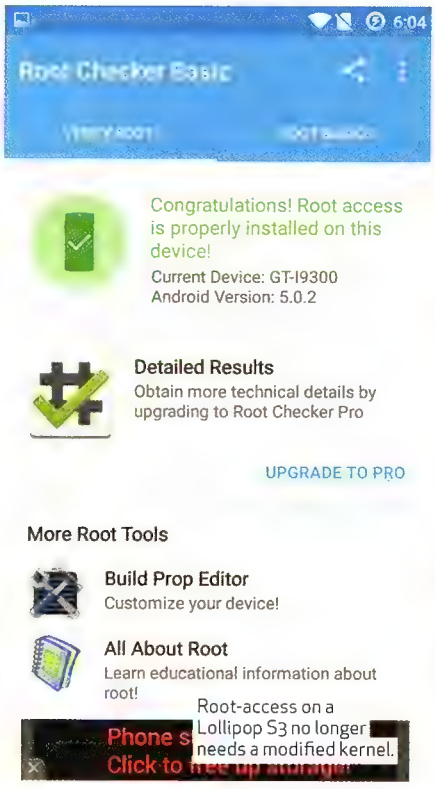
[1] Required for Google Play Store support
[2] Required for off-line speech recognition
[3] Replaces Stock/AOSP version of app included in ROM (to avoid potential problems)
[4] Replaces Stock/AOSP version of app included in ROM (see Advanced Options to override)
[5] Replaces Stock/AOSP version of Gallery included in ROM (see Advanced Options to override)
[6] Only installed when Google Calendar is NOT installed

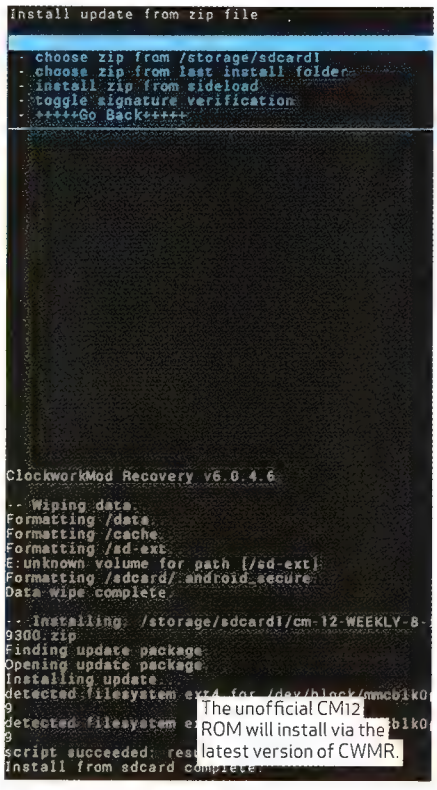

Odin is still the most reliable way to install recovery ROMs to the S3.

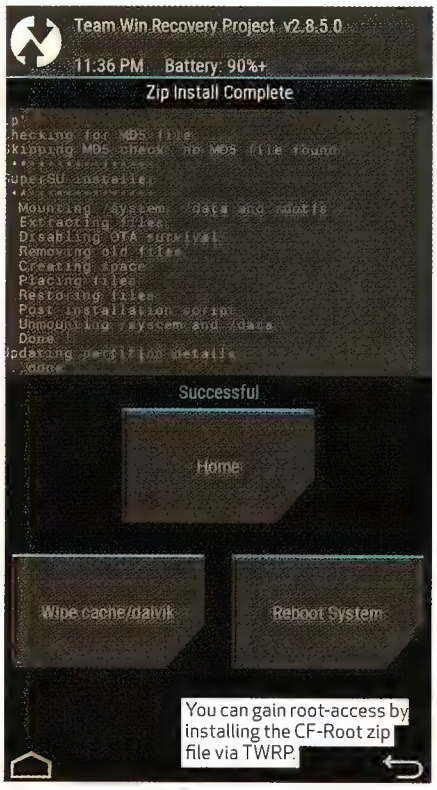
Google's standard Lollipop app launcher running on the Galaxy S3.

FIRST BOOT

The first boot usually takes up to a few minutes as everything is set up, but you should soon see Android begin 'upgrading apps'. If you've gone more than a few minutes and you're still looking at the splash screen, it's likely


Root Checker Basic
Congratulations! Root access is properly installed on this device!
Current Device: GT-I9300
Android Version: 5.0.2
Detailed Results
Obtain more technical details by upgrading to Root Checker Pro
UPGRADE TO PRO
More Root Tools
Build Prop Editor
Customize your device!
All About Root
Learn educational information about root!
Root-access on a Lollipop S3 no longer needs a modified kernel.





a lock-up or a boot-loop. If that's the case, go back to TWRP and make sure you clear the Dalvik cache and reboot. You may even need to reflash the ROM, but investigate beforehand.

GAPPS

Probably the first thing you'll notice once you're up and running with most CM12-based ROMs is the lack of Google Play, Gmail and other Google-associated apps and files. These are Google Apps or 'GApps' for short – proprietary apps CyanogenMod isn't licensed to pre-package into its ROMs. But the good news is you can install GApps as a ROM package separately, in much the same way you installed the Lollipop ROM.

However, if you're still using CWMR as your custom recovery, you'll likely run into problems. We had no trouble using CWMR to install the Lollipop ROM, but even with the latest v6.0.4.6 version, it failed to install the GApps ROM, stopping with the known 'Status 6 error' issue. That's why we recommend you change to TWRP – once we did this, GApps installation was a breeze.

The size of GApps for Lollipop is now quite substantial – the full stock package hits 437MB, but you don't necessarily need all of it. In fact, the Paranoid Android team has split the stock package into five progressively-trimmed 'modular' options – Full (366MB), Mini (232MB), Micro (182MB), Nano (128MB) and Pico (92MB). This last one is just the necessities – the base package with Google Play Store, Play services and Calendar Sync. Check the XDA comparison table and head to **tinyurl.com/myg2f95** for details.

Download the desired GApps zip file to your device storage and flash it from recovery mode as you did the Lollipop ROM image. On reboot, it'll sort itself out, with the Google Play app icon eventually appearing on your device's home screen.

ROOT ACCESS

The other thing you'll probably find missing from at least some unofficial CM12 ROMs is root-access – but what's more, getting root access on Lollipop, in general, has been considerably more difficult than with previous releases. Rather than just running a ROM patch, new under-the-bonnet changes in Lollipop have made it necessary to run a custom/modified kernel for enabling root access through SuperSU or other root tools.

However, the code guru behind the CF-Auto-Root series of root-access ROMs – XDA Developer, Chainfire – has recently come up with a solution that burrows its way in via the Android 'Zygote' service (**tinyurl.com/kvkwnvp**). Zygote is one of the first parts of the Android OS to boot and handles all of the Java code launching. It's also the same vector used by the popular Xposed framework, which, ironically, bypasses the need for full root-access for some functions now.

Chainfire has released a new SuperSU zip package you can now install via TWRP Recovery, but it comes with notable 'may cause boot-loop' warnings. And word is, it'll only need one code-line change from Google and the whole thing will go pear-shaped. Still, we couldn't let this go without trying it out.

To be fair, when news of this new SuperSU package broke, it was v2.27 BETA. We used the latest v2.45 release via TWRP on our Galaxy S3 with this CM12/Lollipop 5.0.2 'Weekly 8' install and we're happy to report we had no bootloops, no issues and complete root-access success. At this stage, it doesn't appear as though Android has plugged the gap SuperSU drives through and with Google pushing on with Lollipop/5.1, we're hopeful they won't bother looking back.

You can download the latest SuperSU from **download.chainfire.eu/695/SuperSU**.

USB AUDIO SUPPORT

One of the new features we love having in Lollipop is generic USB audio device support. Sure enough, the newly Lollipop'd Galaxy S3 recognised our $2 USB DAC from eBay pretty much instantly on plug-in and began feeding through audio to the headphones a few milliseconds later. Same thing with the little Creative Labs Play USB DAC – near-on instant recognition.

Of course, this is something the PC has had for years, but nevertheless, it's a feature that should spawn a whole new range of high-end audio applications for Android tablets and even phones. Apple has had GarageBand to brag about almost since the year dot, but this new USB audio support should usher in a new era of DAW (digital audio workstation) apps and devices turning your phone or

tablet into the ultimate multi-channel digital audio recorder.

Right now, however, you won't get knocked down in the rush of USB audio recorder apps on Google Play, free or paid. The only free one we found that actually recorded anything from the USB audio device was Korean-built app AudioFi. It had all of 100 downloads from Google Play at time of writing (however, 47 votes averaging 4.9 out of 5 doesn't hurt). Still, with Lollipop only running on an estimated 3.3% of devices at the time, it's early days.

PERFORMANCE

Lollipop now implements Android RunTime (ART) full-time instead of Dalvik and that's helped the Galaxy S3's Exynos 4412 quad-core Cortex A9 SoC CPU achieve a little extra something in performance. Running at its default 1.4GHz, our Lollipop'd S3 returned a GeekBench 2 score of 1,855 or around 8% higher than the standard Jelly Bean-powered 1,719 rating.

Unfortunately, 3D graphics performance was never really the Exynos 4412's strong suite and its score of 425 frames on GFXBench's T-Rex test is on par with previous S3 results (but well down on current-gen devices such as the iPhone 6's 1651-frame score).

Going with Lollipop won't necessarily turn your older-gen device into a speed-freak, but it's good to know it won't slow it down, either.

WARNING — TAKE CARE

Custom ROMs are relatively easy to make when the device manufacturer releases source code or binary blobs for the version you're building on. But building a ROM for a version of Android the device maker doesn't officially support takes plenty of skill.

It's also not without its risks. The 'Weekly 8' CM12 ROM we used on the Galaxy S3 smartphone is only classified 'work-in-progress' and 'beta' at time of testing. Throw in the added risks with obtaining root access on Lollipop and things can go wrong at any number of places.

That's why we say, again, that you must ensure you perform a full backup before you do anything to your device – and that you're prepared to wear the consequences if things go pear-shaped and you 'brick' it.

But with Google seemingly no longer interested in patching the WebView component of Android in pre-KitKat releases, sticking with official stock Jelly Bean ROMs that may or may not receive further patches and fixes isn't really a long-term solution.

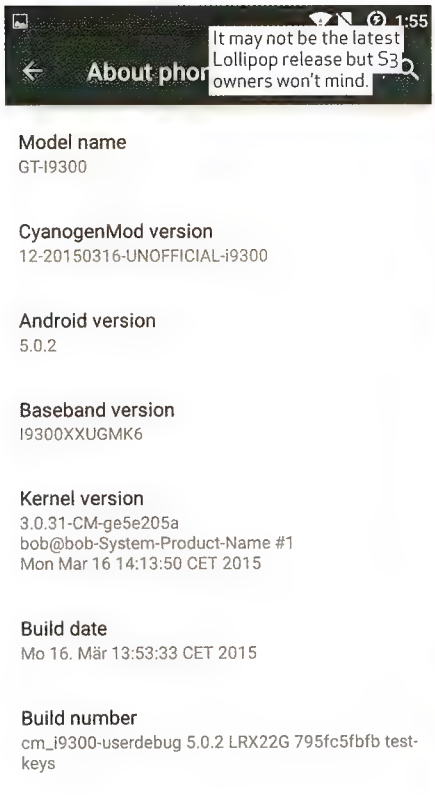
At time of writing, the last official factory ROM for the 3G-version of the Galaxy S3 was Jelly Bean/4.3. Getting it to run Lollipop, having root access – and having the thing perform well with good stability – will go down as a pleasing success. And yep, the camera works nicely. ■

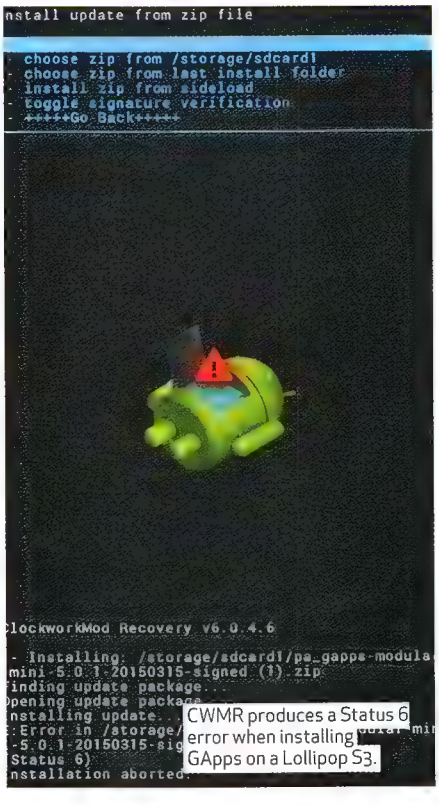
> "Building a ROM for a version of Android the device maker doesn't officially support takes plenty of skill."

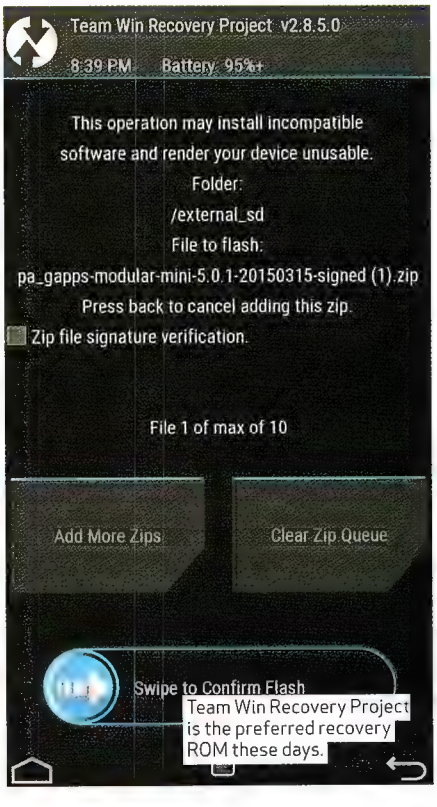
New (unofficial) Galaxy S3 Lollipop/5.0.2 ROMs

Although CyanogenMod was still to officially support the S3 with Lollipop at time of writing, the majority of these ROMs are based on CyanogenMod (CM12) sources, but provided by other developers:

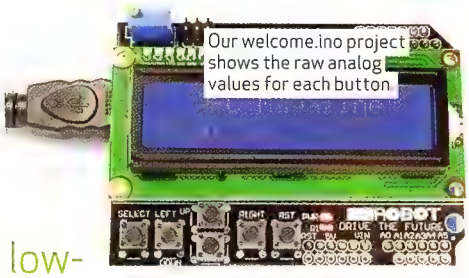
JustArchi/Weekly 8 — **tinyurl.com/kbwh4u8**
Resurrection Remix — **tinyurl.com/resremix**
Paranoid Android Alpha 2 — **tinyurl.com/k8dxguv**
Bliss Pop — **tinyurl.com/blisspop**
Temasek Unofficial CM12 — **tinyurl.com/pvlc2kn**
Team UB — **tinyurl.com/k5z9kmo**






Team Win Recovery Project v2.8.5.0
8:39 PM Battery 95%+
This operation may install incompatible software and render your device unusable.
Folder:
/external_sd
File to flash:
pa_gapps-modular-mini-5.0.1-20150315-signed (1).zip
Press back to cancel adding this zip.
Zip file signature verification.
File 1 of max of 10
Add More Zips
Clear Zip Queue
Swipe to Confirm Flash
Team Win Recovery Project is the preferred recovery ROM these days.

Part 8: Displaying character(s)


Our welcome.ino project shows the raw analog values for each button.

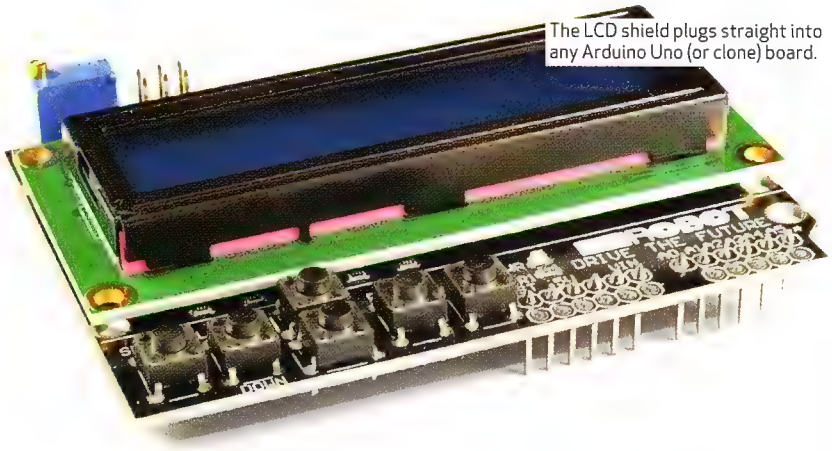
Add a text display to your Arduino projects with a low-cost 16x2 LCD shield. Darren Yates explains how it works.

So far in this Arduino Basics series, we've looked at simple ways of capturing information and either storing it or transmitting it to other devices. But there are times when you want to keep everything self-contained and it'd be great to display data back to the user in a way that's easily understood – text.

One of the most useful add-on boards or 'shields' for Arduino is the 16x2 LCD Keypad Shield, which you'll find on the web and at some electronics stores. It contains a very common Hitachi HD44780 16-character-by-two-line LCD panel plus a six-button keypad.

These Hitachi display panels have been used in everything from test equipment to industrial machinery to digital audio recorders. But what makes them heaps of fun is that they're easy to code and they plug straight into any Arduino Uno board. They come in a range of backlight colours including blue, red and fluoro-yellow.

If you're using a modern version of the Arduino IDE (v1.0.6 or v1.6.1), it already comes with the code libraries you need to make it work.


The LCD shield plugs straight into any Arduino Uno (or clone) board.

HOW THE SHIELD WORKS

Installing the LCD Shield is dead-easy – just line up the pin headers and push the shield into the Arduino Uno board. To get it showing some text, I've written a simple app called welcome.ino that uses the IDE-supplied LiquidCrystal library. It gives you a 'welcome' message but also tracks you pressing the five function buttons.

To start, we use the '#include' statement to include the library, then create a LiquidCrystal object called 'lcd' using the statement:

```
LiquidCrystal
lcd(8,9,4,5,6,7);
```

Those numbers inside the brackets link the shield data I/O pins to the code library. These LCD shields are available from many suppliers but they don't all have the same pinouts. The numbers here are for the DFRobot v1.0 version and its clones, common on eBay.

After that, we create a couple of integer variables and define a range of constants, but the key bit to notice is in the setup() method. First up, we initialise the LCD shield using the lcd.begin(16,2) code line. It tells the code the LCD panel has 16-columns and two rows. Rows and columns are zero-based (means they start counting from zero) and you write text to the display using the 'print' command:

```
lcd.print("   Welcome to");
```

But you can also set the starting or 'cursor' position to anyone of the 16x2 characters on the panel by using the 'setCursor' command:

```
lcd.setCursor(0,1);
```

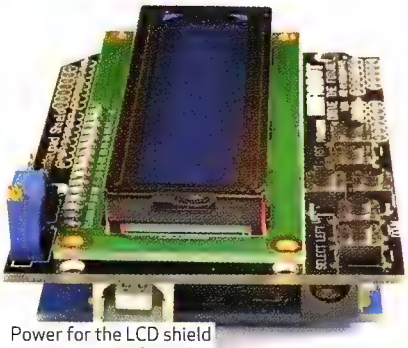
Here, we choose column zero and row one as the starting position. You can then just use another 'print' command to print, whether you're following on from a previous print command or you've used the setCursor command just prior as we have here.

READING THE SHIELD KEYS

However, reading the five function buttons on the shield is a little more complex (the sixth button is just a reset). Rather than map each button to an Arduino digital I/O pin, the shield designers have used a clever trick of wiring them to a resistor network (a string of resistors end to end with connection points in-between) and connecting the whole thing to one of the analog input pins. The benefit is that instead of using five digital I/O lines, we can detect five buttons with just one analog pin.

However, that makes reading the changes a little more difficult because we have to continuously monitor the analog input, check the values created

My Arduino Enigma Cipher Machine uses a 16x2 LCD shield.



Power for the LCD shield comes straight from the Arduino board itself.

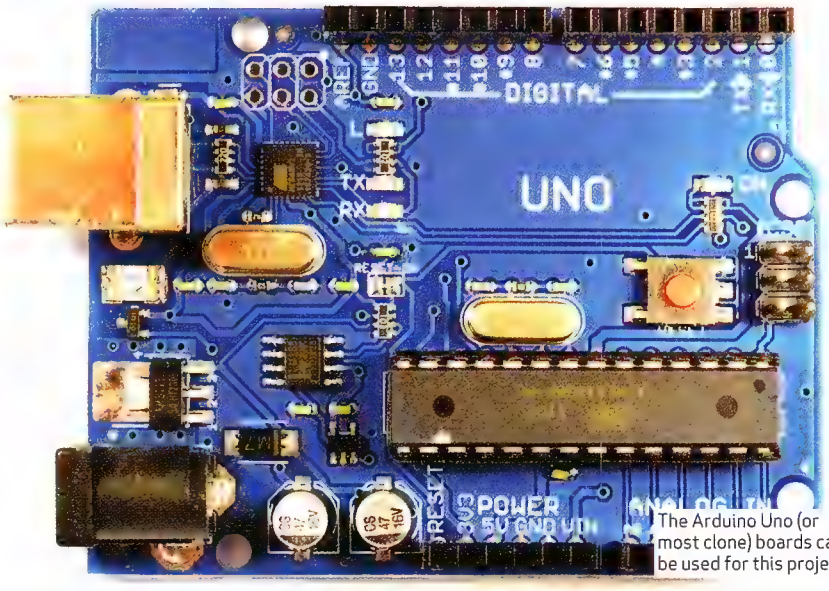
by the buttons and map the results accordingly. Have a look at the loop() method and you can see that after setting the cursor position, we called the checkKeys() method, whose job is to check the 'A0' analog input using the 'analogRead(0)' command and read the buttons' current status.

If you flash the code to your Arduino and use a 16x2 LCD shield, pressing the buttons will give you the appropriate message while you keep pressing the button. The number in brackets is the raw analogRead(0) result coming from the Arduino's analog-to-digital converter (ADC). For example, the Select button gives an ADC reading of '639'. Essentially, we're checking the value and comparing it to known values (the constants we created earlier) to find the button pressed.

THE REFLEX-O-METER!

To pull all of this together and give you something quick to build, I've created a simple game using the LCD shield called 'The Reflex-o-meter' (reflex.ino). You're given one of the five action buttons at random to press and your job is to press that button as soon as possible. The sooner you press it, the higher your score. You get ten attempts and the highest total score is kept and displayed at the start of each new round.

It's no *Angry Birds*, but I found it more addictive than I expected. The best score I can get is 243, so see how you go. If you're sick of the highest score, just press the Reset button and start from scratch (it's lost when you reset or remove the power).



The Arduino Uno (or most clone) boards can be used for this project.

The code for this one is quite a bit more complex because it also includes what's called a 'timer-based software interrupt', which is used to count up and display the time it takes for you to press the right button in tenths of a second. For this, we have to import the excellent 'TimedAction' library (**tinyurl.com/kpnxxzx**) to create a software interrupt every 100-milliseconds that updates the incrementing count on the panel.

GET THE CODE

You'll find the source code pack for both the 'welcome.ino' and 'reflex.ino' projects on our web site at **www.apcmag.com/magstuff**. Download it, unzip it and copy the contents of the /libraries subfolder to the same in your Arduino IDE folder. You'll need to restart the IDE if you already have it open.

If you don't have it yet, grab the Arduino IDE v1.6.1 from the Arduino web site at **arduino.cc/download**. Load up an .ino file, plug in you Arduino Uno board, compile and flash the code to the board and it should automatically boot up and run.

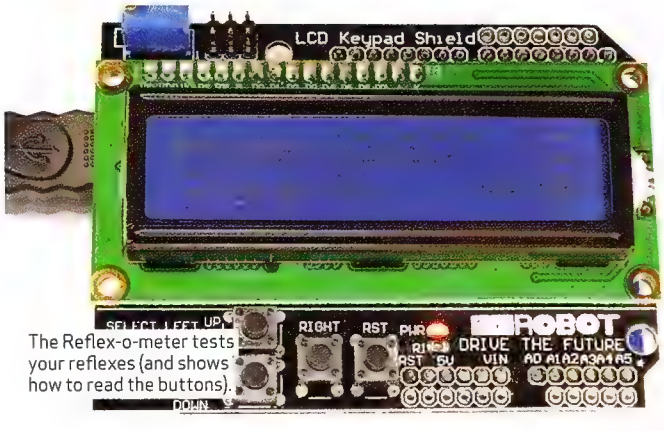
Just make sure you have the LCD shield in place!

GIVE IT A GO

You might think you can't do much with two rows of 16 characters each, but you'd be surprised. Long-time readers of *APC* may remember the Arduino Enigma Cipher Machine I developed last year. It used one of these shields to create an accurate working replica of the famed World War II-era German cipher machine.

If you want your Arduino projects to say something users can read, a 16x2-LCD shield is the simplest and cheapest way to do it. ■

> "You might think you can't do much with two rows of 16 characters each, but you'd be surprised."



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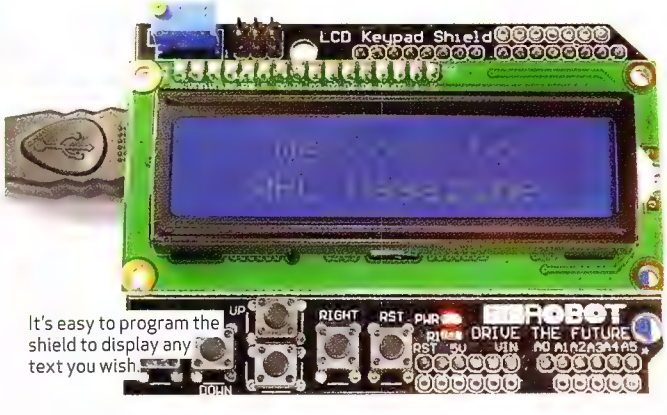

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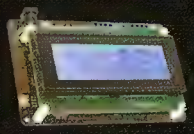

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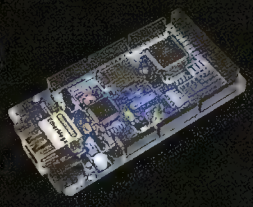

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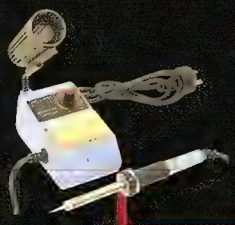

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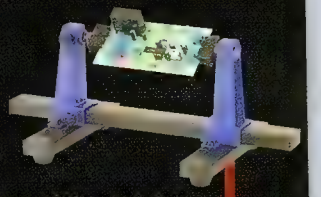

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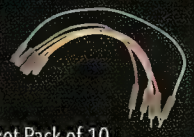

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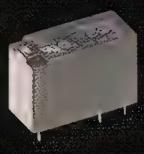

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Part 8: Listen up!

This month, Darren Yates continues looking at Java GUI apps and delves into how to use 'Listeners' to track GUI controls.

Last month, we took in a brief overview of some of the many graphical user interface (GUI) controls the Java language has at its disposal and created our first GUI apps – not that they actually did anything, other than give a look at the basics.

But what you may or may not have noticed is that some of those controls already have considerable functionality as soon as you place them in a frame or panel. The JTextArea for example – you only need to place it on your frame and you can start writing text, even handle copy-and-paste commands. However, for the most part, the controls require extra code to allow their actuation to trigger a function elsewhere in your app.

ALWAYS LISTENING

The problem is, you don't always know just when a user is going to press a button, push a slider or activate a control – so in that case, how do you code for it? You could try and set up something like a for-loop or while-loop to continually monitor the control, see if it has been activated and if not, loop again. But that's a messy and wasteful option, particularly when Java already has various built-in solutions called 'Event Listeners' to handle this very task. The first one we're looking at is the 'ActionListener'.

CODE INTERRUPTED

CPUs have long had a very useful feature called an interrupt, a designated pin or software flag (CPUs usually have a mix of both) that allows an external device or software signal to trigger a change of code running on the CPU. For example, pressing a key on your computer keyboard triggers your word processor to enter the letter representing the key you pressed. The hardware interrupt triggered by the keyboard key activates the code that enters in the appropriate letter.

An ActionListener is a Java object that listens for a JButton in your app being pressed. You attach an ActionListener to your JButton and when a user presses it, an 'ActionEvent' is triggered, launching the code portion you link to that particular ActionListener.

GUIAPP2

A simple example shows how this works. Take a look at the 'GuiApp2.java' project from this month's project pack and you'll see amongst the code, four main GUI controls:

- labelPrompt, a JLabel telling the user 'Type in your name:'
- name, a JTextField the user enters their name into.
- btnGreeting, a JButton the user is asked to press.
- greeting, another JLabel the app uses to display a greeting message.

Looking at the code, we create a JButton object called 'btnGreeting' with the text 'Press me!' via the line:

```
JButton btnGreeting = new
JButton("Press me!");
```

We then attach an ActionListener using the btnGreeting.addActionListener command. Here's how it works:

```
btnGreeting.
addActionListener(new
ActionListener() {
        @Override
        public void
actionPerformed(ActionEvent e)
{
            greeting.
setText("Hello " + name.
getText() +"!");
        }
});
```

To the 'btnGreeting' JButton, we're adding an ActionListener. The ActionListener here is anonymous, referenced by the 'new ActionListener()' statement rather than a named class. The code that launches when the ActionListener is triggered starts at the first open curly-bracket '{' and overrides the standard 'actionPerformed' method. Every ActionListener runs the default 'actionPerformed' method when triggered. The '@Override' command tells Java we want to change or 'override' the default method and make it respond to the trigger.

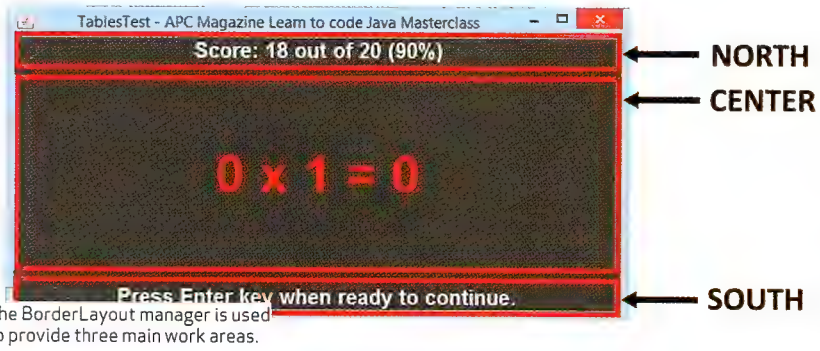
The actual task we want performed appears inside the actionPerformed method – here, we set the text of a JLabel called 'greeting' to show 'Hello' plus the text typed into the 'name' JTextField.

Getting the source code

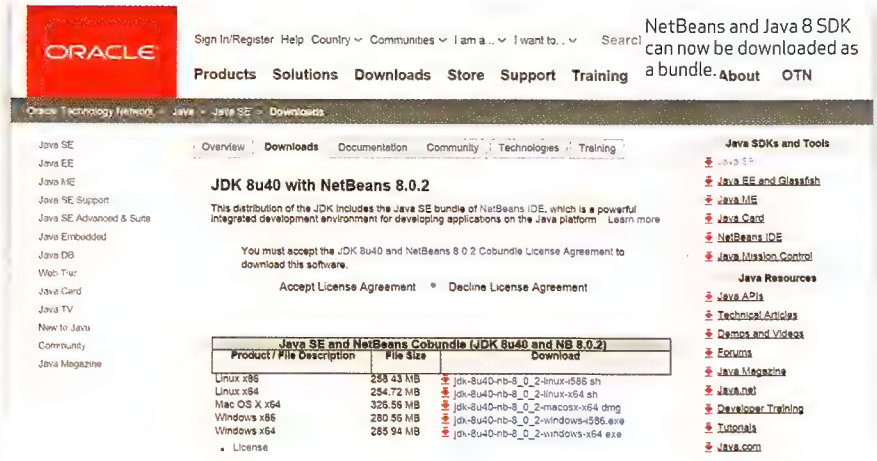
You'll find the source code for this month's project pack on our web site at **www.apcmag.com/magstuff**. Unzip it and in the folder, open up the appropriate project zip file in the NetBeans 8 IDE.

Not involved yet? Grab the latest Java SE Software Development Kit (SDK) / NetBeans 8 bundle from **www.oracle.com/technetwork/java/javase/downloads/index.html**. Alternatively, download and install the Java SE SDK first, then grab NetBeans 8 separately and install it afterwards (do it in this order to ensure NetBeans finds the Java SDK).

BorderLayout positioning


TablesTest - APC Magazine Learn to code Java Masterclass
Score: 18 out of 20 (90%)
0 x 1 = 0
Press Enter key when ready to continue.
NORTH
CENTER
SOUTH

The BorderLayout manager is used to provide three main work areas.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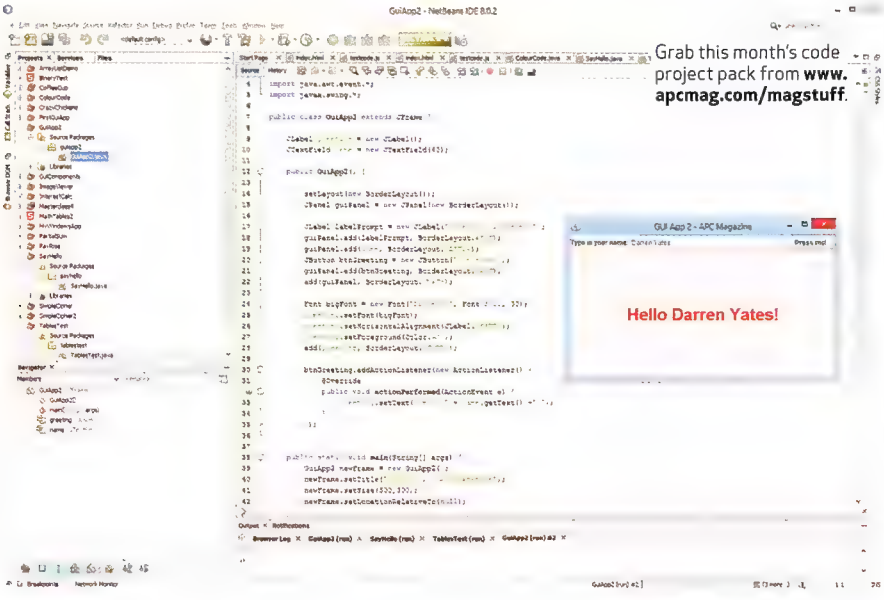
NetBeans and Java 8 SDK can now be downloaded as a bundle.

```
class KeyChecker implements KeyListener {
    @Override
    public void keyPressed(KeyEvent e) {
        int key = e.getKeyCode();
        if (
            if (Character.isDigit(key)) {
                answer += (char)key;
            }
            if (key == KeyEvent.
            if (key == KeyEvent.
            if (key == KeyEvent.
            if (key == KeyEvent.
            if (key == KeyEvent.
            if (key == KeyEvent.
            if (key == KeyEvent.
            if (key == KeyEvent.
            if (key == KeyEvent.
            if (key == KeyEvent.
        }
        if (key == KeyEvent.
            if (
            } else {
                if (
                    runTest();
                } else checkAnswer();
            }
        }
    }
```

Creating a named class to implement a Listener is a more versatile option.



Grab this month's code project pack from **www.apcmag.com/magstuff**.

Every time you press the btnGreeting JButton, an ActionEvent is created, which automatically fires up the attached 'actionPerformed' method. Try it – type in a name, press the button; type in another name, press the button again and you get a different name appear on the screen. An ActionListener simply performs the code inside the actionPerformed method once, then instantly resets, ready to run again on the next request.

Take your time with this and experiment with the code, because this is a fundamental part of GUI app coding called 'event-driven programming' where the user activating or pressing a GUI control creates an 'event', driving the operation of your app.

SAYHELLO

Let's ramp it up a little. Open up the SayHello project and you'll see that it's similar, except this time, we're now changing the background colour and colour of the font each time the user presses the 'Press me!' button, which we've now called 'btnPress'. Again, we attach an ActionListener to the button, followed by our own code.

If you have a look, we're doing a couple of extra things this time. First up, if you change the size of the app frame by clicking and dragging one of the corners, you change the font size proportionally on the next JButton press. This is done using the command:

```
labelHello.setFont(new
Font("Cambria",Font.
BOLD,getWidth()/30));
```

Here, we're creating a new text font object and adding it to the JLabel. A font object has three parameters – the font name ('Cambria' in this case), a font style (Font.BOLD) and the font size. For this last parameter, we're setting the font size by getting the width of the frame using the 'getWidth()' function and dividing the result by 30, giving us a font size proportional to the JFrame width.

The next six lines create six integer variables, each with a random number created by the Math.random() function between 0 and 255 – three for the foreground colour and three for the background. We then apply each set of three numbers as new 'RGB' colours and set the 'foreground' and 'background' parameters of the 'labelHello' JLabel.

Good programming languages allow you to set colours as an 'RGB' set of three 8-bit numbers (0 to 255) for red, green and blue. That gives you the ability to create colours from any of 16.7 million (24-bit) options.

Finally, we set the 'labelHello' text to say hello, but also list the R, G and B colour components. This can be a very useful way of coming up with different colour combinations and knowing the RGB parameters to use. Each time you press the 'Press me!' button, the 'actionPerformed' code runs again and creates a new random set of RGB foreground and background colours, giving you a completely different look.

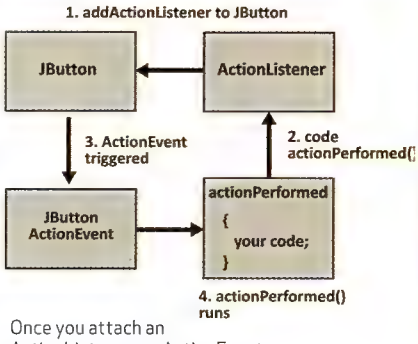
LEARN YOUR TIMES TABLES

Again, let's crank things up a little more, this time with something a little more competitive. How was your maths back in primary school? Open up the TablesTest project and you'll be able to test out how good you are at your times tables from 0x to 12x. The app keeps track of the number of questions you're asked, the number you answer correctly and provides the correct answer when you answer incorrectly, prompting you to continue when you're ready by pressing the Enter key.

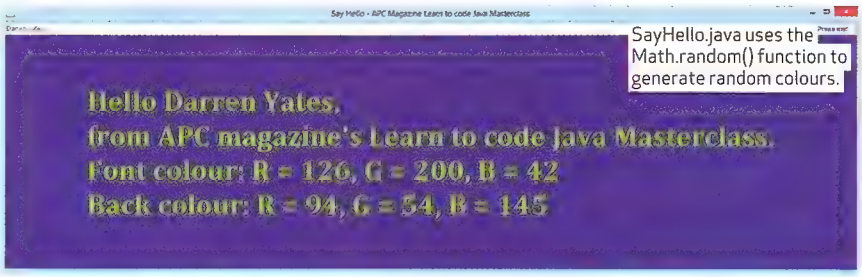
KEYLISTENER

If you look at the code, you'll see around line 45, we do what we did before and add an ActionListener to the 'btnGo' JButton. You should be getting the hang of how it works. But in order to answer a multiplication question, we need to now wait for the user to enter in something via the keyboard. This time, we use another 'event listener' called the 'KeyListener'. Just as an ActionListener listens for an ActionEvent indicating a JButton to be pressed, a KeyListener waits for a KeyEvent – any key to be pressed.

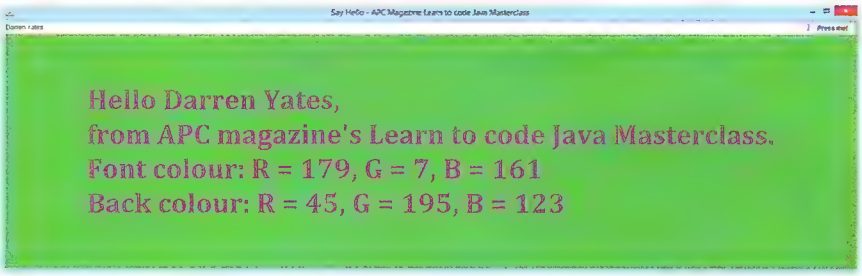
Basic flow of an ActionListener

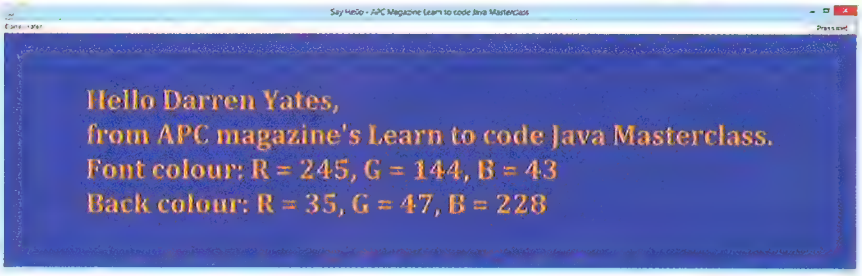


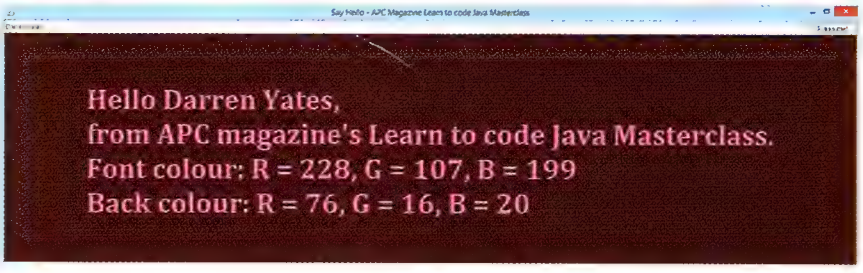
Once you attach an ActionListener, an ActionEvent triggers your code.

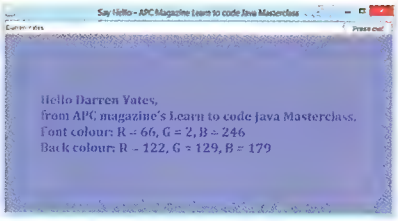


SayHello.java uses the Math.random() function to generate random colours.



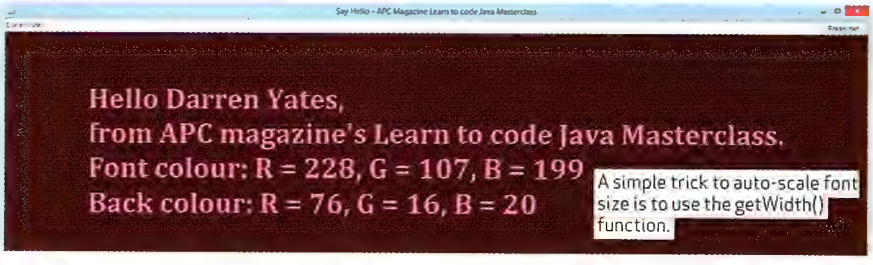






Simple font scaling can be achieved by setting the font size to a proportion of the getWidth() value.

```
labelHello.setFont(new Font("Cambria",Font.BOLD,getWidth()/30));
```



A simple trick to auto-scale font size is to use the getWidth() function.

NAMED VS ANONYMOUS

Java is an example of what's known as an object-oriented programming (OOP) language, where the idea is that instead of focusing on a bunch of functions or 'methods', you build your app around the idea of 'objects', where objects have attributes that define their state and methods that determine how the objects function. For example, a 'car' object will have 'fuelCapacity' and 'fuelUseRate' attributes and a 'getRange()' method to calculate how far that car can travel on a tank of fuel based on those attributes.

The fundamental building block or template of any object is a class and you can create instances or copies of a class in two ways – you can name them or you can create them anonymously.

The ActionListener and KeyListener are examples of event listeners and so far, we've been using the anonymous approach by invoking 'new ActionListener()' and adding our code direct to the listener. Anonymous listeners are fine for small tasks, helping reduce the amount of code you have to write as well as reducing app complexity.

But for larger applications, you can create your own specific listener class and if you look at the TablesTest project, you'll see I've done that when it comes to the KeyChecker listener. Here, there is a code block or 'class' called KeyChecker that builds on or 'implements' the KeyListener interface. We create the class at the point of the code beginning:

```
class KeyChecker implements
KeyListener {
```

We then create an instance of our KeyChecker class and call it 'keyChecker' (lowercase 'k' here to indicate we're creating an object variable) with the code line:

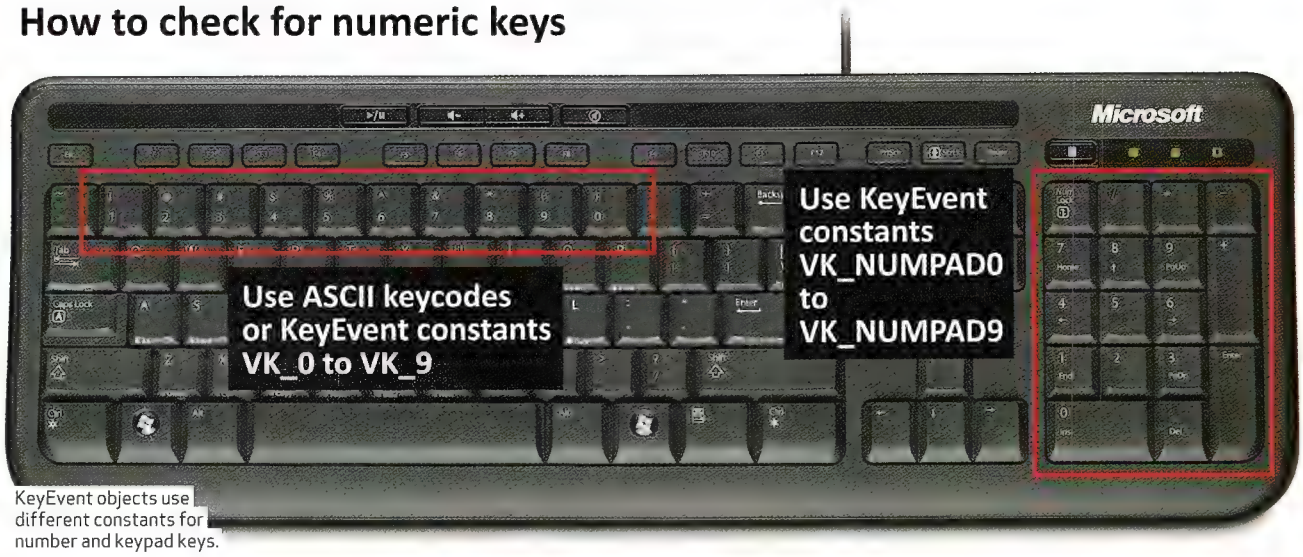
```
KeyChecker keyChecker = new
KeyChecker();
```

Finally, we attach the keyChecker interface to the JLabel similar to before, but using the addKeyListener command this time via the code-line:

```
labelQuestion.
addKeyListener(keyChecker);
```

So, instead of using 'labelQuestion.addKeyListener (new KeyListener)', we create a new class that implements the KeyListener, add our own code to it, create an instance of the new KeyListener class and give it a variable name, then attach that to the JLabel. Named listeners are more versatile as we'll see in coming weeks.

How to check for numeric keys



KeyEvent objects use different constants for number and keypad keys.

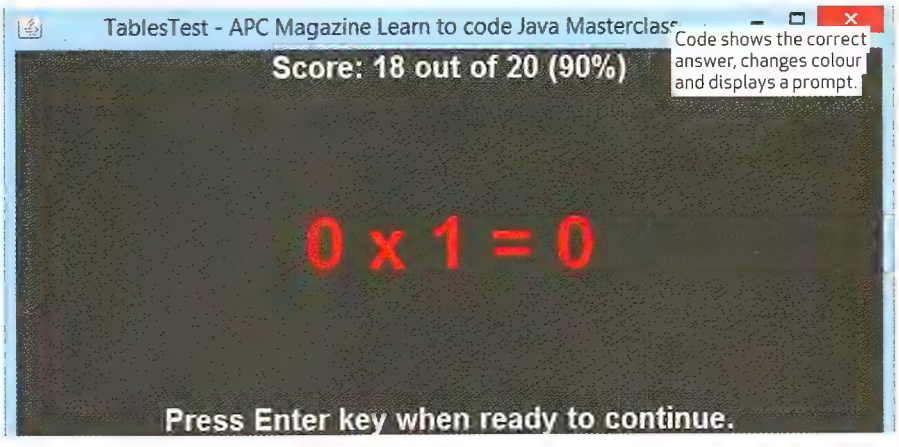
In the KeyChecker class, we set about listening specifically for the numeric keys – but typical US-style 101-key keyboards have two sets of numeric keys and KeyListener distinguishes the standard numeric keys from those of the numeric keypad. So, we need to check for both. You check for the standard keys either by using their ASCII key codes or via 'KeyEvent' constants 'VK_0' to 'VK_9' and listen for the numeric keypad keys by looking for constants 'VK_NUMPAD0' to 'VK_NUMPAD9'.

THAT'S NOT BIG...

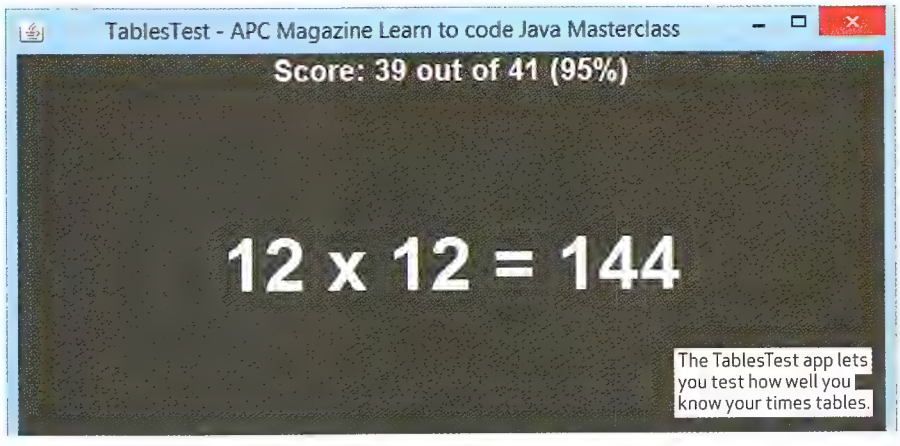
TablesTest is by far the largest project we've undertaken so far at around 130 lines of code. But really, that's nothing – Google recently announced that one component of its Android operating system, the WebView component used for displaying web content without launching a web browser, has over five million lines of code!

SCOPE OF A VARIABLE

Nonetheless, TablesTest is big enough to show different concepts. For example, if you look at the code, straight after we set the TablesTest class (line 12), we declare and initialise a range of object variables. When you see variables declared at this point – that is, outside a method – they are usually 'global' variables, meaning they retain their current value across the app class. A variable declared/initialised inside a method is known as a 'local' variable and only exists inside that method. This is called the 'scope' of a variable – where in the context of the app code it exists. It also means you can have multiple local variables with the same name, each in different methods that are independent of each other – just remember that the local variable in one method is completely different to a local variable of the same name in another method.



Code shows the correct answer, changes colour and displays a prompt.



The TablesTest app lets you test how well you know your times tables.

PLAY AROUND

Please don't just read this story – load up these projects and take them for a spin. Change the code, edit things, see what happens. It's easy to suffer 'analysis paralysis' when you first start coding, thinking you have to understand everything before you start coding. Don't worry about making mistakes – just get in there and get your hands dirty!

What's great about writing your own code is that you choose how it works. It's like writing a book or creating your own artwork – it's your expression. As long as you follow the correct syntax and the code works, there are any number of ways you can write an app to do the same thing. Some ways might be faster or more efficient than others, but in the end, it's your creation. The worst thing would be to not even start trying.

Next month, we'll continue with GUI apps and look at how to load and save simple files. See you then. ■

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disc contents

» OUR SELECTION OF EXCLUSIVE FULL-VERSION PROGRAMS

ISSUE 415, MAY 2015

MAKE WINDOWS SQUEAKY CLEAN

Clear out your registry for better performance with Ashampoo Registry Cleaner 2015

FULL VERSION WORTH $14.95

Do you remember how trouble-free and fast your new PC was? Regain some of that performance by updating the Windows registry with the Ashampoo Registry Cleaner. You'll be amazed how it will quickly and easily improve the performance of your PC!

RIP & EDIT MUSIC THE EASY WAY

Hassle free music management with Abelssoft mp3 Cutter 2015

FULL VERSION WORTH $20

mp3 Cutter provides an all-in-one MP3 ripping application with a very attractive appearance and easy to navigate user interface. Users don't require any previous knowledge about MP3 processing, nor do they need to worry about tedious pop-ups and multi-screen navigation: everything you need, down to a waveform of your audio, is displayed on the same panel.

PLUS!

SYSTEM REQUIREMENTS

- A DVD-ROM reader or burner.
- The *APC* disc is designed for use with up-to-date browsers (for example, Internet Explorer, Chrome, Firefox).
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- An internet connection may be required for online registration of software before use.
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- Check the disc using a virus scanner complete with the latest antivirus data updates. The disc was checked before burning, but new viruses are being discovered all the time.
- Back up any important system and data files. It is not recommended that the software contained on these discs be installed on production machines.
- If you have any questions regarding the use of the *APC* disc, click the 'Help' button at the top of the screen.

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- Insert the disc into a CD/DVD-ROM reader or burner and your web browser should automatically load the interface. If not, launch your web browser and load the default.html file from the root directory of the disc.

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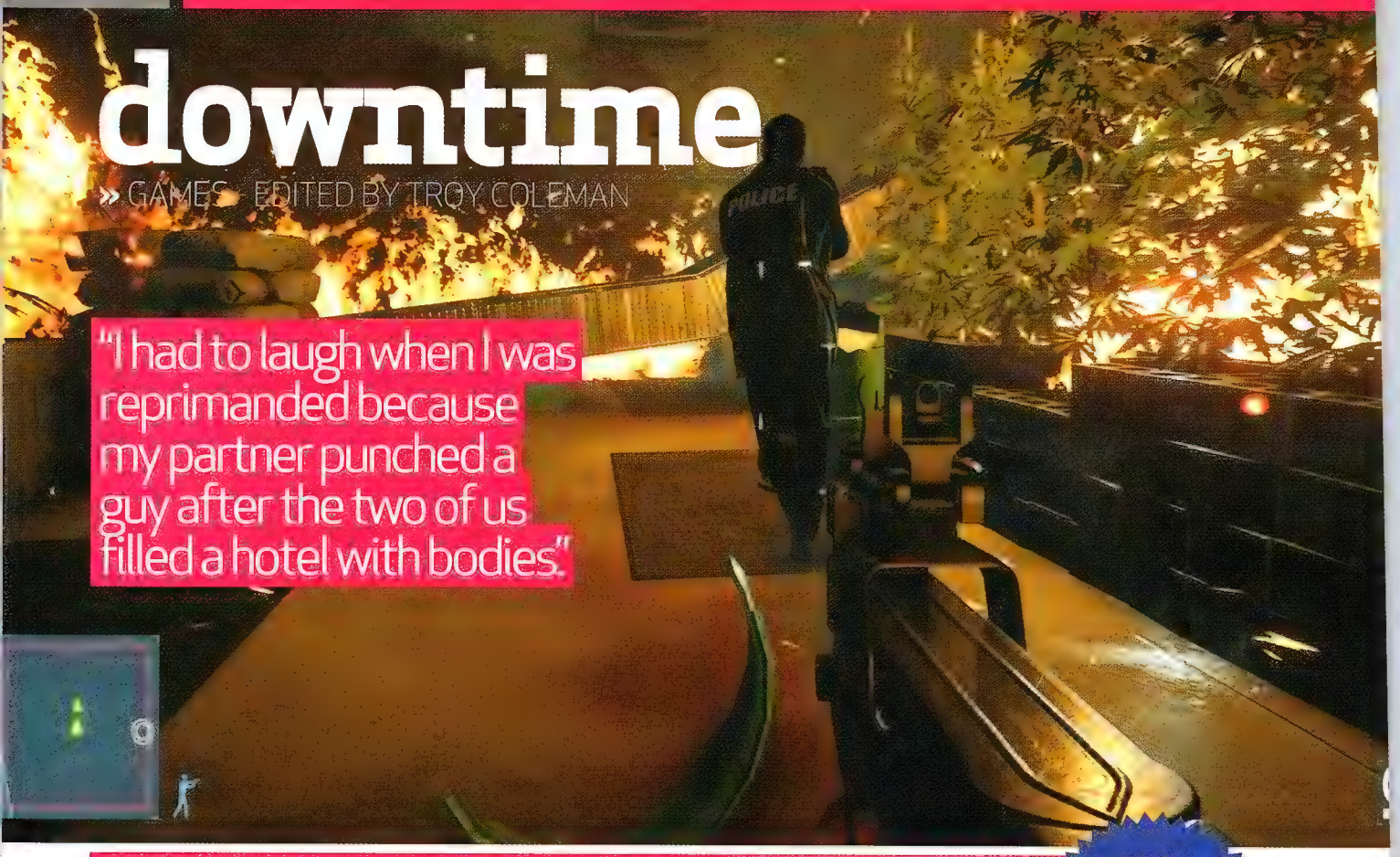


FROM $89.95 | PC, PS4, XBOX ONE | WWW.BATTLEFIELD.COM/HARDLINE

Battlefield Hardline

An exploding spectacle of reckless law enforcement.

apc RECOMMENDS

Battlefield Hardline's multiplayer has launched without disaster. There are glitches and dumb physics, but hell, it works, and it's fun. After *Battlefield 4*, that deserves a clap. A slow, slightly sarcastic clap, but a clap.

It's fun, but in the words of Roger Murtaugh, I'm getting too old for this shit. It's exhausting. I pine for *Battlefield 1942's* simple structures, sprawling terrain, and Lee-Enfield rifles. The same fundamentals are still here – big maps, classes, vehicles, 64 players – but the speed and firepower make it a constant struggle to live long enough to enjoy them.

It's got the rhythm of an old car lurching forward and then bouncing back off its front tyres. I spawn into a helicopter and blow up immediately, or spawn on my squadmate and instantly trade lives (somehow) with a guy right in front of me, or spawn and get run over, or spawn and drive head first into an RPG. Objectives are pelted with explosives and there's always someone with a shotgun around the corner (or crouching in the corner). When crappy, short lives like these pile up one after the other, the screen gets a good flipping off.

The only thing I wouldn't mind going faster are the unlocks. There aren't all that many guns, but not having the good ones is a barrier to fun. I spent the first several hours struggling with the Mechanic's default MP5K, losing short range duels I felt I should have won. So I switched to the Operator's assault rifle and had a better experience. And then I realised I had a battlepack sitting unopened with my Deluxe Edition ACWR carbine. Suddenly I'm getting tons of kills, and that's some BS. My apparent skill level shouldn't jump because I have a special weapon. I like progression systems because they give me something to work toward, but I'm interested in lateral progression. It shouldn't feel like I'm walking head first into a gale of bullets for hours until I progress.

GLITCH SHOOTER

And while *Battlefield's* signature glitchy physics anomalies can be fun, I have a lot of questions about my bullets. *Hardline* has not launched disastrously, but I have experienced occasional frustrations – hits that don't register, or being killed through a door before I should have even been visible to the enemy.

But if all that doesn't aggravate you so much that you step away, there's plenty to enjoy. My favourite mode is Hotwire, which epitomises *Hardline's* speed. It's still about capturing and controlling points, but those points are now cars that must be driven around the map. Because driving cars in circles is how you uphold the law, and also break it.

There are three basic activities: finding RPGs/blowing up cars, providing air support, and driving or riding in cars. You also get little shootouts when you cross paths with the enemy on the way. It's hard not to have fun bouncing around in a car, music blaring while leaning out the window to spray bullets.

The big problem is that while the new cars are mostly nice to control on a keyboard, they sometimes want to go faster than the server, stuttering and rubberbanding against each other as the physics sorts itself out. One time I collided with a motorcycle and flew into the ocean – and I was in a sedan.

Heist, in which the criminals must steal two packages and deliver them, works well on maps big enough to support it. In some cases it's a meatgrinder, but the Bank Heist map especially can be tactically rewarding with a good team.

I also really enjoy Blood Money on maps with vehicles. Both teams must retrieve cash from a central repository and

deliver it to their vaults, but can also steal from each other's vaults. There's just constantly stuff to do. Grab an armoured truck and drive it into the enemy vault if you want, or just chase around their money carriers, or steal some cash yourself, or find a Stinger and blow up a helicopter. You're going to be blown up too, any second now, so just go nuts. It's a madhouse. It's tiring. And it's an enjoyable, loud, farcical chaos that will probably get old, but for now is a big, dumb exploding playground.

Conquest and TDM are back, too. Conquest is conquest, and still fun even though it has nothing to do with the cops and robbers theme, and TDM is where people go to speed through the progression – that hasn't changed. There are also two new 5v5 modes, and while they're fine (*Counter-Strike* on big, open maps, essentially), they're not being played much. I don't expect *Hardline* to compete with *CS:GO* anyway.

THIN BLUE LIE

The campaign is to *The Shield* what *Call of Duty* is to Tom Clancy novels. They're both stories of betrayal and corruption – tough men with tough jawlines making tough choices – but any grounding in actual police work is upended by car chases, shootouts and last second escapes against impossible odds. The story's fine: you, a good and honest cop, are a pawn in a corrupt force's drug game, and it's time to take out the trash.

Police work is simple in *Hardline*: arrest criminals, shoot criminals when you can't arrest them, find evidence. It has so little basis in reality, my initial unease about the subject matter – modern police corruption and brutality isn't a frivolous subject, especially right now – almost wholly evaporated. I had to laugh when I was reprimanded because my partner punched a guy after the two of us filled a hotel with bodies. Both you and the bad guys are gun-toting lunatics. It's a lot like *Max Payne* in that respect.

It plays a little like *Payne*, too. There's no shootdodging, but each room is something to try and try again until the puzzle is solved. Generally, I solved the puzzle like Max would: by shooting everyone. I'm crouch-walking between cover, conserving ammo and taking shots carefully, and it doesn't take much to kill me. This is true, at least, on the hardest mode, which is how I recommend you play. It's a decent shooter campaign, with the freedom to take on most areas from a variety of positions and with the arsenal and gadgets of my choosing.

Unlike Max, Nick Mendoza can actually do police stuff. Flashing your badge at isolated enemies causes them to drop their guns and surrender, at which point you can take them down and cuff them. Then they fall asleep. Seriously, there are 'Z's above their heads.

The catch is that you can't arrest more than three guys at once, and if you're spotted cuffing someone, they'll open fire. It's the most ridiculous thing about *Hardline's* campaign, and not a great deal of fun. Later in the game, I was in a small room with about eight guys. Tossing a shell draws guards to me one at a time so they can be arrested in my secluded arrestin' spot. I cleared the room slowly, building a pile of sleeping goons in my little corner. Hard as it would've been, the John Wick approach would've been more fun. And the fact that you can arrest criminals makes it even weirder that you can shoot them, bringing back some of that unease. Either I'm Max Payne or I'm Lennie Briscoe, either this is a shooter or it's *Police Quest* – I don't think you can have it both ways.

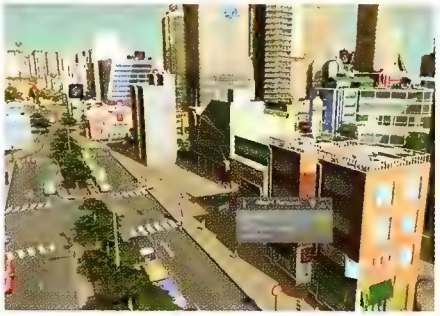
I'm rewarded for police-like behaviour with points, but it doesn't feel worth it. Sometimes you have to collect evidence to progress, but I didn't go above and beyond. Because it's boring. Oh, and I had a couple of mandatory stealth and car chase sequences that weren't much fun.

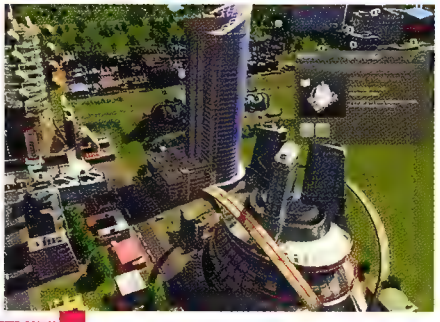
When it's not infuriating, *Hardline* is weird, brutal fun. The multiplayer is the important bit, and it's a parade of points, mini-achievements, goofy car crashes, motorcycles flying into helicopters, and incendiary grenades. It's too much too fast, with a low time-to-kill that makes every life fleeting. It's not elegant, but the lawless bedlam has its moments. When I'm doing well, getting kills and screaming around a map in a stolen sports car, it's worth it. ■ **Tyler Wilde**

Verdict

A hard campaign and over-stimulating but fun multiplayer make for a good time amid infuriating deaths.

★★★★☆





apc HOT PRODUCT

FROM $59.95 | PS4, XO, PC, PS3, 360 | WWW.PARADOXPLAZA.COM/CITIES-SKYLINES

Cities: Skylines

Ground up fun and satisfying city-building sim.

***Cities: Skylines* didn't have to stretch far to trump 2013's *SimCity*: it just had to be a good city-builder with an expansive area to build in, support for custom content, and no always-on DRM. *Skylines* offers all this. It's also fun and addictive.**

The biggest challenges involve roads and traffic, which is not unexpected given that this comes from the same developer/publisher duo as *Cities in Motion*. Laying down roads is easy. Laying down roads that make sense, not so much.

It's not just traffic congestion you have to worry about, it's logical traffic routes. Figuring out the best roads and intersections takes time, experimentation, and close scrutiny, something I think many players will enjoy. If you'd rather build unbroken tree-lined avenues and long, winding roads you certainly can, but be prepared for your city to lose a good deal of functionality.

The ability to create separate districts is a great feature, allowing you to tinker with laws and regulations without having to unleash them citywide, such as those for recycling, free public transport, and legal drug use. You can tax your districts differently, and even ban industrial traffic in congested areas (just be sure to provide heavy trucks with an alternate route). You can create industrial districts to focus on oil and mining, logging, farming, or general industry.

FRIENDLY SKIES

In addition to managing the physical aspects of your city, you'll have to keep an eye on your bank account and supplement it with loans, decide what to budget for utilities and services, tweak taxes for residents and business, and play with various policies. Nothing about the simulation feels terribly deep, at least economically, and apart from focusing on specific types of industries, or choosing office towers over factories, none of my cities have felt particularly specialised. That suits me fine, though players looking for a deeply complex city simulation might be a little disappointed.

At times, *Skylines* is intensely satisfying, such as when solving a troublesome traffic snarl or when all the buildings in a district begin levelling up because you've provided the right combination of services and amenities. At times it's soothing, like when flying the free camera around or peering down at the tiny NPCs living in your creation. It can also be terrifically tense: the citizens of *Skylines* are pretty tolerant, but let them suffer power outages or other discomforts too long and they'll abandon you in droves.

Unique buildings such as stadiums and opera houses become available as your city grows, even a space elevator and a large hadron collider. Transportation options include metro tubes, airports, and trains and ships for both passengers and industrial use. Your available building space, initially just a single square of land, grows as well. There's a healthy five-by-five grid of which you can officially purchase nine tiles of 2 x 2km each, but there's already a mod in the workshop that lets you buy and build on all 25 tiles.

Plumbing feels like busywork, demand for new buildings can stall, and driver AI is a little off-kilter, but these issues haven't done much to dampen my enjoyment. Due to the map and asset editor, I suspect the Steam Workshop will quickly fill with custom creations. Top it off with smooth performance and a reasonable price, and I suspect no matter what your interest in city building, casual or intense, there's a lot here to like.

■ **Christopher Livingston**

Verdict

There're a handful of flaws, but this fun and addictive sim scratches that city-building itch that others can't.

★★★★½

$49.95 | XBOX360, XBOX ONE | WWW.2K.COM/GAMES/SID-MEIERS-STARSHIPS

Sid Meier's Starships

Plays more like a half-arsed mobile game conversion.

When I think of starships, I think of SF book covers. I think of impossibly tall silver spheroids drifting over mountains, of rusting hulks trapped between the stars. I think of the glories of *EVE*, *Homeworld* and *Elite*. *Starships*, alas, launches in a small window and has little ambition.

It's a sub-GalCiv casual game, almost certainly designed with mobile as the lead platform. It's an extremely cut-down version of the Civ formula, without charm, looks or innovation. You start by choosing your faction and leader, which provides you with bonuses, and then you're left looking at a very simply-modelled image of a few planets with inexplicable numbers all around them. An information pane pops up, telling you a few basics, but there's no formal tutorial though the game is so simple it hardly needs one. On this galactic map, you improve planets and send your (single) fleet around to accept quests to take over planets. Each planet has mildly different characteristics, resulting in different production of the four resources, different ship upgrade prices, and the potential to build a wonder at many of them. But the balance is off. One fast-growing planet I found supplied more of every resource than the rest of my empire, enabling me to win just by building wonders.

At this level you can also conduct the most limited diplomacy I've ever encountered in a game. You can get information from your characterless enemies about their ships and empire, with no explanation as to why they're telling you all their weaknesses. Or you can declare war. That's it. The research tree is similarly rudimentary, providing straight upgrades to your weapons and tech without explaining how they differ from each ship's individual upgrades.

In the similarly dual-level *Total War* games, the often weaker campaign metagame has always been carried by the peerless battle engine. That's not true here; while the quests always sound interesting, they boil down to turn-based battles on a simple 2D plane packed with static asteroids, wormholes and planets, where you deploy the same fleet over and over. Your fleet is the game's sole redeeming feature. You have a handful of ships, and you can upgrade each in multiple ways. As they improve, they change name and appearance to reflect their new role.

At the time of writing, the game is also struggling under a mass of bugs. Many players can't start it at all; others suffer from game-breaking flaws. I found I could build cities when I had no food to build them with, and that the AI could win using victory conditions that were supposedly removed.

Starships isn't terrible, but it isn't the polished product you'd expect from a studio with Firaxis's history. Even judged against Firaxis's other mobile games, *Civ: Rev* and *Ace Patrol*, this is small and crude. ■ **Dan Griliopoulos**

Verdict

Get a cardboard box, paint it silver, sit in it and pretend you're Captain Kirk. There, I've just saved you $50..

★★½☆☆

LA Cops

Evokes *Hotline Miami* but doesn't quite hit those standards..

US$34.99 | PC
WWW.LA-COPS.COM

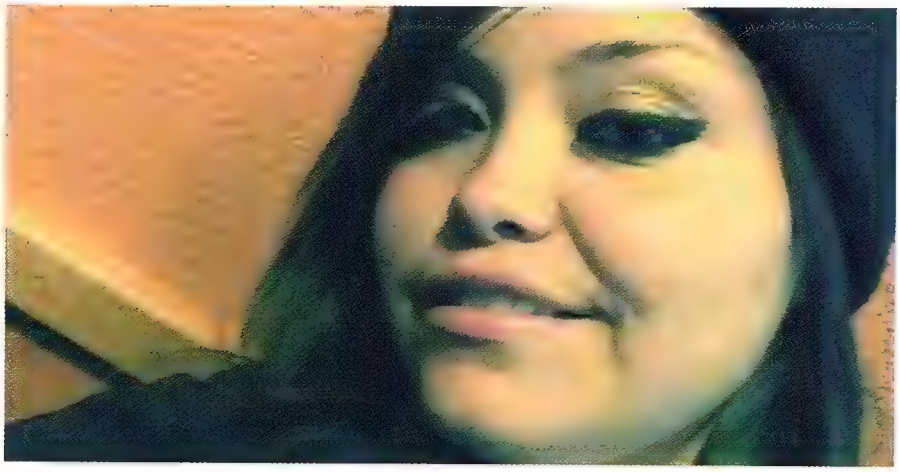
On a piece of coffee-stained, doughnut-crumbed paper, *LA Cops* is great. It's an unashamed 3D clone of top-down shooter *Hotline Miami*, but its rich '70s era Los Angeles vibe coats it with a much more lighthearted sense of humour. The game's unique shtick is its reliance on two playable characters for each level. Each cop is a classic '70s stereotype with over the top hair-dos, overdone accents, audacious sideburns and surnames like Kowalski. You can switch between them as you go, and the intention is clearly for you to invent interesting ways to double-team unsuspecting drug lords and low-level goons. It's pretty familiar stuff. You burst into isolated levels to massacre a bunch of bad guys — hostage-takers, drug dealers and everything in between. You have a melee attack which doubles up as a way to arrest bad guys, making possible a non-lethal run where you sneak up behind foes and whack the cuffs on 'em. You'll get a higher score, but lose the most satisfying method of interaction: guns. The unique dual-character thing falls apart, too. I would often try to place one of my cops in interesting positions on the map, only to get bored and just brute force my way through because it was the most fun way to play. Why spend so much time slowly moving through the levels as a unit when you can more easily just use one cop? ■ **Sam White**

The Emoji Keyboard

Type Emoji on your Mac! *heart* *heart* *wink* *point*

As human communication continues to deteriorate, heading (winky) face-first into a terrifying future where all humans express themselves exclusively through memes and clip art, a new Kickstarter campaign aims to get humanity there even faster, with a proposed Emoji Keyboard that lets people know how you really feel.

The Emoji Keyboard is a silicone cover with various Emoji printed over the keys. Used in tandem with downloadable software, your Mac keyboard layout can be transformed with over 150 Emoji shortcuts. The keyboard will continue to function as normal, however the Caps Lock button will now activate Emoji mode. *Confounded face*.



IPHONE THIEF IDENTITY REVEALED DURING SELFIE SHOOTING SPREE, BUSTED BY OWN MOTHER

THIEF'S SELFIES AUTOMATICALLY UPLOADED TO OWNER'S FACEBOOK PAGE

A message to would-be thieves: kleptomania and narcissism do not mix. A 17-year-old Denver iPhone thief was busted by her own mother after the numerous selfies she took were automatically posted to the iPhone owner's Facebook page. Over 30 photos were uploaded to 23-year-old Rawley Bingham's Facebook account, showing the thief having a jolly-old time around town. Eventually, the pictures were shown on Colorado's prime time news, alerting the phone snatcher's mother to her daughter's thieving ways. The selfie bandit is set to return the phone to Bingham, though there's no word on whether charges will be filed.

Apple is Hitler, says Chinese smartphone maker

CHINESE CEO'S COMMENTS SURE TO CAUSE A FÜHRER AMONGST APPLE FANS

Jia Yueting, CEO of Chinese internet video site LeTV has lashed out at Apple, with a post on his verified Weibo page comparing the company to Nazis. The post depicts a cartoon Hitler wearing a red armband with the Nazi swastika replaced by an Apple logo, and was shared to over five million of the billionaire CEO's followers. Intended to tease the upcoming LeTV X900 smartphone, the image also includes the text "Crowdsourced, freedom vs arrogance, tyranny" in regards to Apple's ecosystem. Jia continued by labelling Apple an "arrogant regime" that "developers around the world love yet hate."

Two Californian men arrested for shooting lasers at police helicopters

SUSPECTS' BRAINS APPARENTLY NOT FULLY OPERATIONAL

Two men in separate parts of California were arrested for firing lasers at law enforcement helicopters within the last month. One of the arrested men, Johnny Quenga of Fresno, has found himself in more trouble than normal, as the patrol car that was sent to apprehend him got into a serious accident, leaving both officers hospitalised. As a result, the helicopter crew was left in danger for a longer period of time, leading to an additional "interfering with the safe operation of an aircraft" charge. Now, both charges could land Quenga a maximum sentence of 25 years in prison. ■

apc PRESENTS

PC BUILDER

THE COMPLETE GUIDE TO BUILDING A PC

ANATOMY

RIG BUILD

PRODUCT RANGE

HOW TO

GLOSSARY

Welcome

Building your own PC is one of the best home-brew tasks you'll ever undertake.

Over the last few decades the mass market has made us a little bit lazy, but building your own PC isn't actually as complex as it may seem; it just consists of buying the parts you need and putting it all together. Though it isn't always cheaper to do it this way, the art of building your own is the path to pride and accomplishment.

Handily, it also emboldens us to fix our creations if they ever go wrong, because we understand the whys and wherefores. So, by putting together a computer yourself, you may be able to save a little money down the road.

Building your own PC also gives you a much greater set of options to play with, allowing you to get exactly the kind of PC you want, in exactly the specification you desire. Choosing your own parts also allows you to choose the best, most reliable parts you can afford.

So if you need a machine for power-sucking tasks, a home-built desktop PC is pretty much the perfect answer.

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THE TEAM

WORDS
Editor-in-Chief: Dan Gardiner (dan.gardiner@futurenet.com)
Production Editor: Melanie Pike (melanie.pike@futurenet.com)

PICTURES
Creative Director: Troy Coleman (troy.coleman@futurenet.com)
Senior Designer: Nykke Coleman
Designer: Sharnee Brisbourne

THE BUSINESS END
Sales Director: Paul Marttila (paul.marttila@futurenet.com)

THE SUITS (BUT NO TIES)
Chief Operating Officer: Neville Daniels (neville.daniels@futurenet.com)

CONTACT INFORMATION
Tel: 02 9955 2677 Fax: 02 9955 2688
Address: Future Publishing Australia, PO Box 1077, Mount Street, North Sydney, NSW 2059

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Anatomy of a PC

You get back what you put in. Discover how to choose the right parts for your perfect build with our detailed guide to components.

Design improvements mean that it's never been easier to build your own PC – but it's still difficult to pick the right components for a brand new build. Choosing the wrong parts comes with a host of potential pitfalls.

Some aren't serious, but others could be terminal. Plugging an SSD into the wrong SATA port only limits speeds, but your PC won't even boot if the processor and motherboard aren't compatible. Picking a motherboard without certain chipsets or slots makes it tricky to fit future components – and choosing a power supply without much grunt will make a graphics upgrade difficult.

This guide makes it easier to pick the correct components for any kind of PC – from bargain-basement machines to full-throttle gaming systems. Every major component is covered, and we've examined the relationships between these parts to ensure you'll pick components that work well together.

CPU & GPU

The processor and graphics card are two of the most important components inside a PC; none go as far when it comes to determining how a system will handle intensive software, multi-tasking and top-tier games.

They're closely linked. If you've got a fantastic processor but a poor graphics card, demanding tasks will be held up as the GPU struggles to handle its load. The same is true at the other end of the scale – a great GPU can be hamstrung by a weak processor.

Several factors need to be considered when choosing processors. The clock speed should be your first port of call – the higher that figure, the faster the chip. It's less of an issue these days, because most processors have ample pace – as long as you've got more than 3GHz, you should be OK.

Most processors use temporary overclocking to generate more speed. This is called boosting, but it won't make a huge difference – you'll only get a few hundred extra megahertz.

Also consider cores. Low-end chips typically come with at least two, which is enough for lighter computing, but anything more intensive – including high-end gaming – requires four. It's even better if the chip has Hyper-

Threading, which means each core addresses two concurrent tasks. AMD processors function similarly – like Intel, its quad-core parts handle eight application threads.

It's easy to spot which chips are ripe for overclocking; Intel parts with unlocked multipliers have the 'K' suffix, and overclockable AMD hardware is labelled as Black Edition. AMD and Intel both sell quad-core processors with multi-threaded operations, high clock speeds and boosting. Your choice determines your motherboard – and, therefore, a host of other features.

Just as much goes into picking a graphics card. A good GPU needs a potent combination of stream processors, clock speed and fast memory. The stream processor functions similarly to processor cores, but the different demands of graphical workloads mean that you'll find hundreds inside low-end GPU cores, and thousands inside high-end cards. They're clocked at certain speeds, and the higher both these figures are the better.

These days, you'll want at least 3GB of GDDR5 for serious gaming, and the faster the better. High-end cards have more, and soon you'll want 8GB. That's because the Xbox One and PS4 have 8GB of RAM, and many games are now developed for consoles and ported to PCs – so memory parity is important.

Graphics card choices don't stop at the PCB. Consider the size of the card, because some won't fit inside smaller cases. Also check that the heatsink won't block other motherboard slots, and ensure that the power supply has the correct connectors – some high-end cards require two eight-pin plugs.

If you're buying a low-end processor, don't indulge in one of the market's most expensive graphics cards – you won't see the full potential of an expensive card if it's underpinned by an Intel Pentium or Core i3 part. That bottlenecking is less of an issue if you're building at the mid-range or beyond – processors and graphics cards have enough grunt to get the job done.

It's part of the reason why we've chosen Intel's Core i5-4690 for our mid-range build on page 114. It ticks every box: four 3.5GHz Hyper-Threaded cores provide excellent power, two cores can use Turbo Boost to hit 3.9GHz,

THE LITTLE DETAILS

Pay attention to the fine print as well as the big picture when building a PC, and you'll be much happier.

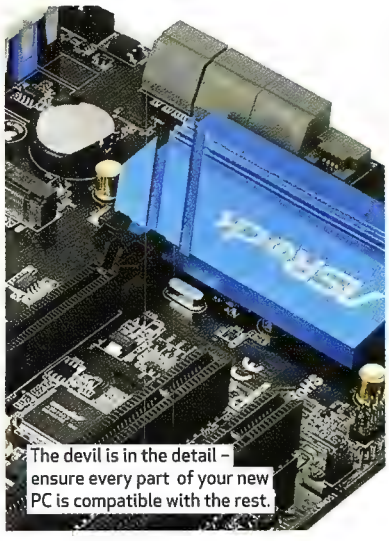
Some motherboards are littered with smaller features worth consideration. Check the heatsinks that surround the processor, for instance — they could make it difficult to install larger CPU coolers. The same goes for the memory sockets, which can cause cooler conflicts if they're too close to the processor.

If you're keen on tweaking, check the rest of the motherboard. Higher-end boards have on-board buttons, voltage monitoring points, dual-UEFI software modes and more options that are handy for enthusiasts.

Before buying a case, check what fans are included — most include one or two. If you're building a more powerful machine, consider investing in more cooling; most cases support two or three 120mm fans at the front, two or more in the roof, and even fans in the base.

A host of other steps can be taken to ensure the build goes smoothly. Don't forget to install the small golden risers before screwing in the motherboard, and don't forget to plug in the connectors at the bottom of the motherboard, too — these wire up the power and reset buttons at the front of your case.

There are plenty of common pitfalls when it comes to choosing components that work well together — and then putting them together when they've all arrived. Follow these tips to avoid common mistakes, and you're less likely to go wrong.



The devil is in the detail – ensure every part of your new PC is compatible with the rest.

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ROOM TO GROW

Ideally, you want to design your rig to work well now while also offering plenty of room for future upgrades. It's always worth keeping an eye on the future when putting together a new system, because it's usually cheaper and easier to give an existing machine a boost than to buy a new rig.

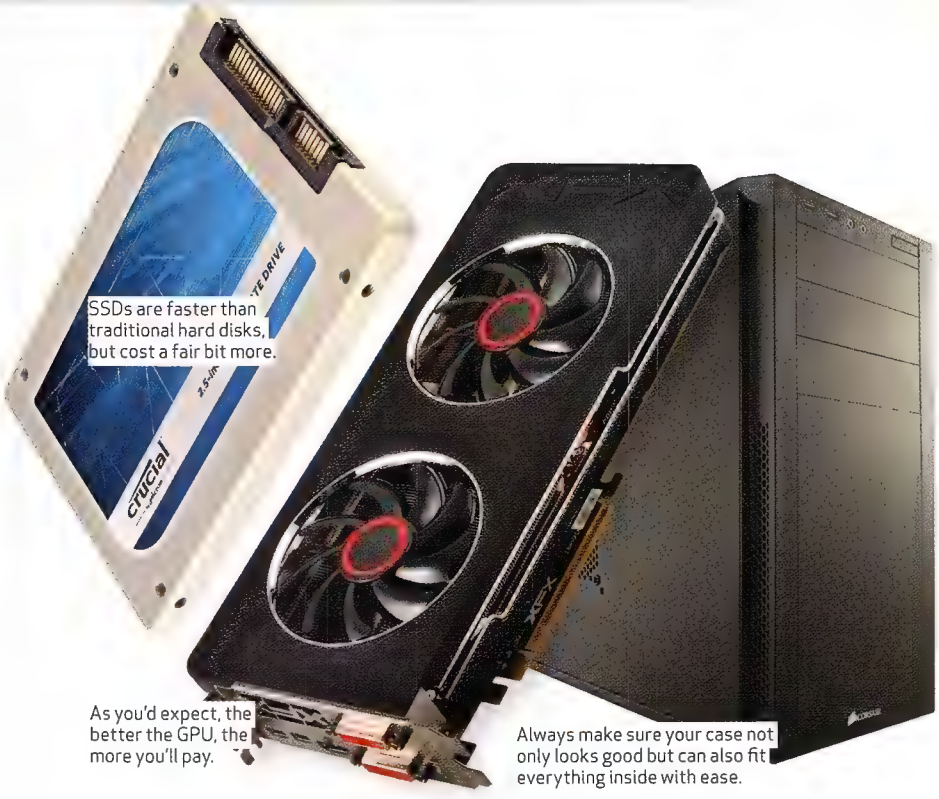
The motherboard is key to upgrading. If you've picked a board with a second PCI-Express x16 slot — and it runs at 8x speed, at least — then you've got enough bandwidth to fit a second graphics card, which can theoretically double gaming performance.

Choosing an Intel board with an LGA 1150 processor socket, will mean that the processor can be swapped easily for a faster chip. The same is true if you're building on the AMD side of the fence — the AM3+ socket used for FX processors will continue to be used for the foreseeable future.

You'll also likely want a board with an M.2 connector. It's a bit more obscure, but it's worth having one of these, because it's likely to be the next big format used for SSD storage.

Other areas are worth consideration for future upgrades. Extra 2.5-inch and 3.5-inch bays in the case can be used for more storage; spare memory sockets can be used to add a second pair of dual-channel memory sticks; and PCI-Express x1 and PCI slots can both be used for other expansion cards — Wi-Fi and sound cards are both popular additions to PCs.

Think about what you may want to add to your PC in the future.



SSDs are faster than traditional hard disks, but cost a fair bit more.

As you'd expect, the better the GPU, the more you'll pay.

Always make sure your case not only looks good but can also fit everything inside with ease.

and there's plenty of cache. Its $330 price is high, but it's worth it — this is a crucial component.

It uses Intel's LGA 1150 processor socket, which means it's compatible with many motherboards. It trades blows with AMD's FX-9370, which costs about the same, but Intel wins in several performance categories and has better power consumption.

Don't discount AMD when it comes to graphics however. The Radeon R9 280X has dipped below $350 — and it beats Nvidia's pricier GeForce GTX 770 in several benchmarks. There's even enough power to play many games across three screens.

THE MOTHER LODE

Your processor and graphics card — and every other component — plug into the motherboard. It's the one bit of kit that links every part, so it's one of the most important things to get right.

Motherboards are available in several different form factors. These classifications govern the size of the board, and help determine its features. The largest use the ATX form factor, and below that there's Micro-ATX. Beyond that you'll find Mini-ITX, but that's only worth considering if you want to build a smaller system.

The processor slots in at the top of the board, and memory sockets are found alongside. The middle is dominated by PCI-Express x16 slots, one of which is used for the graphics card, and most also have a combination of PCI-Express x1 and PCI slots. The right-hand side houses SATA ports for storage; the bottom edge serves up connectors for audio, power and I/O; and the top-left corner provides the back-panel connectors.

Amid all of this is the chipset — a crucial component that determines which features are included. There's a surprising amount of variation found here — some chipsets are low-end parts that lack features but appear on cheaper boards, while others include every bell and whistle on the market.

Take chipsets available for Intel's LGA 1150 socket. The low-end H81 is restricted to two SATA 6Gbps ports and two USB 3 connectors, while the enthusiast Z97 supports six of each.

It's important to consider your other components when looking at motherboard slots provided by different motherboards. SSDs need SATA 6Gbps connectors, and machines with dual-graphics require at least two PCI-Express x16 slots with lots of bandwidth. Most motherboards support 32GB of memory, which is enough for almost everyone — but check if you need more before you buy.

Think about the software, too. Most BIOS applications have been replaced by UEFI software, which adds better graphics and mouse control. If you want to overclock or tweak, it's worth investigating — if it's easy to use and has plenty of options, it makes life simpler.

Every one of these options needs to be considered against price — and the type of PC you're trying to build. Boards range from less than $90 to more than $600, and it's pointless paying over the odds for features you won't use.

At the mid-range, the LGA 1150 socket and Z97 chipset ensure good compatibility and features, generally offer support for plenty of memory, and often have a good mix of slots — giving you options for dual-graphics and other expansion cards if desired.

Make sure you're not paying for power you'll never use.

The more RAM you have, the faster your PC will run.

STORAGE & MEMORY

Memory slots in beside the processor and temporarily stores critical files. Right now, the most popular type is DDR3, and that's what we'll be using – but DDR4, which is faster but more expensive, has begun to appear.

Picking memory isn't just about choosing between DDR3 and DDR4 – the speed and capacity is vital. Basic machines can get by with 4GB, but 8GB is the minimum for more intensive tasks. Pick memory that runs at 1,600MHz or higher for rapid performance – but the faster the better. Check your motherboard's support for different amounts and speeds before buying, and make sure you're running in dual-channel mode for best performance.

The storage market has split over the past few years, with hard disks and SSDs existing in tandem and coming with their own pros and cons. Hard disks are cheaper with higher capacities, but they're slower and less reliable. SSDs are faster and less prone to failure, but they're pricier and have smaller capacities.

It's worth using both in a PC if the budget allows. Most systems use SSDs as boot drives, so Windows and applications benefit from faster boot and load times, with a larger hard disk used for software and files that aren't so dependent on speed.

Picking a hard disk is easy – make sure it's got 64MB of cache and runs at 7,200rpm, and then choose your capacity. There's more to look for when buying an SSD – read and write speeds should be above 500MB/s and 300MB/s, and TRIM support is vital. Check for endurance, too – the higher rating the better. Finally, check that the motherboard has a SATA 6Gbps socket.

A CASE IN POINT

The enclosure ties the rest of the rig together, and it's one of the key areas when it comes to making an aesthetic statement – but there's more to choosing than picking one that looks good. It's important to make sure a case is big enough for the components. If you choose an ATX board, select a case that's compatible with this form factor – and that logic follows if you've chosen a Micro-ATX or Mini-ITX board, too.

That's not the only component with size considerations. If a PC has a large graphics card, make sure that its hulking frame fits – many enclosures have removable hard disk cages that facilitate large cards. And, talking of storage, count up your drives and make sure the case has enough bays – you need 2.5-inch bays for SSDs and 3.5-inch for hard disks. If you're using a chunky CPU cooler, check its height, because some rub against side panels.

Cable-routing and ease of building also play a part. Invest in a case with a sensible layout. Keeping cables out of the way doesn't just look good, but it improves air-flow, too. Look for enclosures with removable front, side and top panels, cable-routing cut-outs and a motherboard tray.

Choose a meagre power supply and your system won't run – but choose too much and you'll be paying over the odds for abilities you won't use. Make sure you've got the right connectors, because it's no good buying a high-end graphics card and a PSU that can't connect. This is especially important for multi-GPU rigs, because some power supplies don't include four PCI power plugs. If your budget allows, it's worth opting for a modular PSU. These have connectors that can be added or removed, which allows more versatility. It's a boon for adding more hardware to a rig as well as keeping your cables tidy. ■

BOOM OR BUST?

Our $800 system on page 114 is an ideal entry-level PC, but it's easy to modify the specification if you want to splash out to make it better. That's true of any specification thanks to a host of easy upgrades.

Several cheap components can improve a new PC. Wireless networking cards don't cost the earth and can take the hassle out of getting the system connected to the internet, and sound cards are another worthwhile addition — if you've got good speakers or high-quality headphones, they can take movies and games to the next level.

Our Pentium processor runs at stock speed and uses the standard Intel cooler, but it's an unlocked chip that can run faster with overclocking. You'll need a beefier cooler — decent models start at around $50 — but it's possible to easily get the chip beyond 4GHz with just a few BIOS tweaks.

Other upgrades aren't as expensive or as obvious as simply opting for a higher-end processor or graphics card.

An extra $60 or $70 on the graphics card will take you from a GTX 750 Ti to a more well-rounded Radeon R9 270X, which start at around $240 on the street.

Upgrading the CPU is a little trickier at this price point. You can spend an extra $60 and step up to the Core i3-4160, which is still a dual-core chip but it also has Hyper-Threading, meaning it will perform better in certain applications. Is it actually worth a 50% jump in price? Not quite, in our book. In fact, we'd really want to step up to the quad-core Core i5-4460, at around $250, to make the upgrade worthwhile.

If you've got altogether lesser demands of your budget rig, you could save even more money and opt for an AMD APU. It's a processor that includes a low-end Radeon graphics core, and top models can handle mid-level computing assignments while also playing games at reasonable quality.

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Build your perfect PC

Constructing a new PC can be a daunting task, but we aim to make it easy.

One of the joys of owning a PC is that you can upgrade it as you go. Need higher frame rates in games? Drop in a newer graphics card. Want more power elsewhere? Grab a new processor or go for that old favourite: the memory boost. There's a wealth of upgrades that can transform your machine, plus you can change slowly over time to suit your budget, so you rarely have to suffer a sluggish rig for long. Every now and then, the best possible upgrade is to dump your current rig and start afresh by building a whole new machine from scratch. That's what this PC builder's guide is aimed at.

So what sort of machine should you build? Which items are important? Which work well together? How much should you be budgeting for? That's a lot of questions, and getting the right answers means having to go and research all the current trends in order to make the best decision.

Before you do that, though, take a look at our guide, which you can follow in its entirety or use as a starting point to customise your own design. Either way, you'll discover that we've taken the hard work out of the equation and presented you with two machines that fit completely different budgets. Our entry-level PC is specifically designed to get you gaming at 1080p for a bargain price and our mid-range rig will cope with pretty much anything up to 2,560 x 1,440-pixels.

On these pages are our recommendations for putting together these two machines. These rigs all include a screen in the ticket price, so if you're keeping your existing monitor then you'll have more cash to spend elsewhere. And what's our recommendation if you find yourself with that pleasant problem? Either get a more powerful GPU or a larger SSD. Happy building you lovely people!

ENTRY-LEVEL

MSI B85M-E45	$85
INTEL PENTIUM G3258	$95
G.SKILL RIPJAWSX 2 X 2GB DDR3 1,600MHZ	$60
ASUS GTX750TI-OC-2GD5	$185
OCZ ARC 100 240GB	$150
INTEL STOCK COOLER	N/A
THERMALTAKE LITEPOWER 450W	N/A
THERMALTAKE VERSA H15	$90
LITEON IHAS124-14 24X DVD±RW	$25
AOC E2250SWDNK	$150
TOTAL	$840

MID-RANGE

ASUS Z97-A	$210
INTEL CORE I5-4690	$300
CORSAIR VENGEANCE LP 8GB	$150
SAPPHIRE RADEON R9 290 TRI-X	$430
CRUCIAL MX100 512GB	$320
ENERMAX ETS-T40	$55
SILVERSTONE STRIDER ESSENTIAL 600W	$105
CORSAIR CARBIDE 200R	$85
NONE	N/A
AOC I2757FH	$340
TOTAL	$2,005

HOW TO BUY... A GPU

The graphics card is one of the biggest upgrade purchases you can make for your performance PC. It's also one of the easiest — open up the case, slot it in and power it up. Simple as juicing citrus.

So, making the right choice is vital, especially as there are so many different options around at the moment. Essentially, it's almost entirely down to your budget. Buying the most powerful single-GPU card you can afford is always a good rule of thumb, but it's always worth ensuring that your power supply is capable of feeding it enough juice and has the right connectors.

So long as your PSU has a pair of 8-pin PCIe power connectors, you should be golded, but always check that your PSU's capacity matches the recommended spec for your prospective GPU. Finally, a word on multi-GPU purchases. Beware. You can get better average frame rates, but an equivalently priced single card is always going to be a better experience.

AN SSD

Right now the SSD market is in a transitional state. We're shifting from the classic SATA and AHCI-based design towards a new gen of hyper-quick SSDs running over the PCIe interface with a new NVMe protocol. But we're not there yet, so how do you choose a drive for your current build?

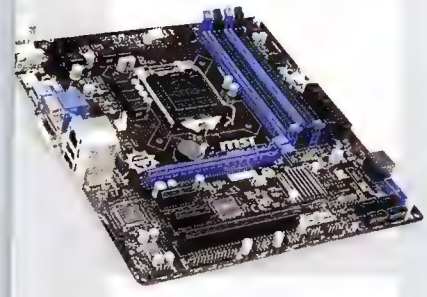
There are already M.2 drives available, like the Samsung XP941 and 850 EVOs, and Crucial's MX200s. Plextor has also released M.2 drives as well, but they're all still using the old AHCI protocol. That's an issue because even though the PCIe interface offers a huge amount of bandwidth, the drives are all going through reams of legacy checks, designed for the days of mechanical hard drives, which hobbles general performance. So right now you're still arguably better off opting for a SATA-based version. When the NVMe drives do arrive in force, you can merely switch that to data duties and fill out the single M.2 slot your motherboard offers.

Entry-level

When every dollar counts, spend them wisely.

MOTHERBOARD
MSI B85M-E45

It's basic, but for $85 this MSI board packs all the essentials with a bit of growing room thanks to four RAM slots, two USB 3.0s and four SATA 6Gbps.

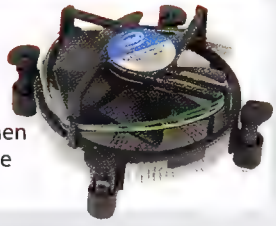


CPU
Intel Pentium G3258

Poor AMD, it's a clean sweep for Intel on all our recommended rigs. The new Pentium is simply the best budget chip around right now, offering Haswell for peanuts.

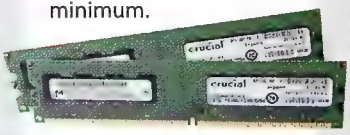
CPU COOLER
Intel stock cooler

The Pentium Anniversary chip is a very cool-running CPU, even when overclocked. We managed a stable 4.2GHz on this stock cooler.



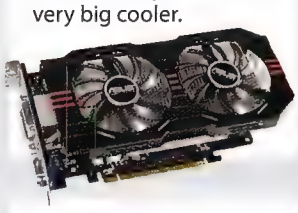
MEMORY
G.Skill 4GB 1600MHz DDR3

Memory pricing continues to be incredibly volatile, but it's still a great time to squeeze more sticks into your rig. You really should see 4GB as the minimum.



GRAPHICS CARD
ASUS GTX750TI-OC-2GD5

Nvidia's latest budget GPU is quite a feat of engineering because of that Maxwell architecture. The ASUS card is a bargain, with a very big cooler.



SOLID-STATE DRIVE
OCZ ARC 100 240GB

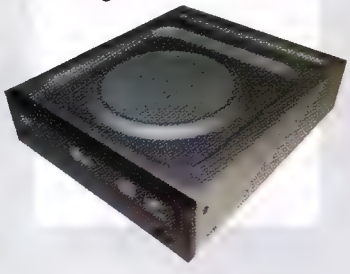
OCZ's ARC 100 drive may not be the quickest, but it's great value, incredibly consistent and quicker than Crucial's MX100 at this capacity.

POWER SUPPLY
Thermaltake Litepower

This PSU actually comes bundled in with the Thermaltake case. It's a 450W job, which is enough to power our frugal parts elsewhere and has all the PCIe leads you need for setting up this build.

OPTICAL DRIVE
LiteOn IHAS124 DVD+RW

We really wonder whether you actually need an optical drive anymore, but for now we'll err on the side of caution and include one in the list. Don't feel bad if you forget to buy it though.



CHASSIS
Thermaltake Versa H15

At $90 this simple micro-ATX case is a core part of this build. It's enough to get the job done and its smaller size means it won't take up much space. Plus, it includes a 450W power supply. Nice.

SCREEN
AOC E2250SWDNK

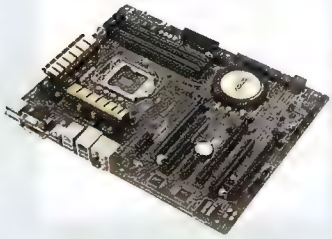
This 21.5-inch panel has a native resolution of 1,920 x 1,080 and looks pretty good despite that ridiculously low price tag. It's no IPS-beater, but it'll do for half the cash.

Mid-range

A stunning rig doesn't have to cost a fortune.

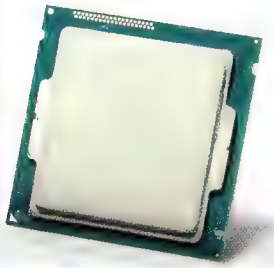
MOTHERBOARD
ASUS Z97-A

We've seen a lot of Z97 motherboards since this ASUS offering landed, but nothing newer has managed to push it off this list. Great features at a great price. Simple really.



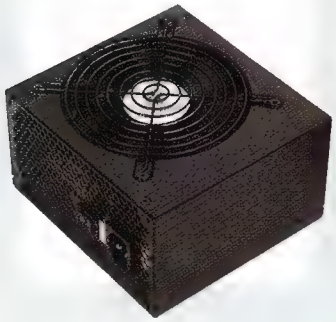
CPU
Intel Core i5-4690

For almost the same price as the ol' 4670 you can pick up one of the newer Devil's Canyon CPUs. It's only got a 100MHz clock boost, but there's more than enough performance here overall.



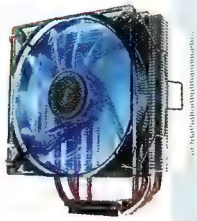
POWER SUPPLY
SilverStone Strider 600W

If you want to build a performance machine, you're going to need a powerful PSU. This 600W baby will power the rig, with extra to spare.



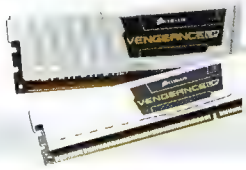
CPU COOLER
Enermax ETS-T40

Enermax has simply amazed us with this, its first CPU cooler. The performance is excellent, the price is astonishing, it's easy to fit and it isn't so big that it limits your case or motherboard choices.



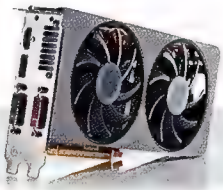
MEMORY
Corsair Vengeance LP 8GB

This pair of 4GB sticks will give you all the performance you could ever want, and they're in stormtrooper white. They'll only take up two slots in the board for upgrading, too.



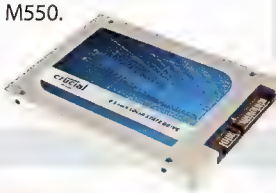
GRAPHICS CARD
Sapphire Radeon R9 290

In order to shift units out of the channel, AMD's top cards of the last gen are dropping in price. The R9 290 is great value at about $430 — although if you can stretch, go for a 290X for $50 extra.



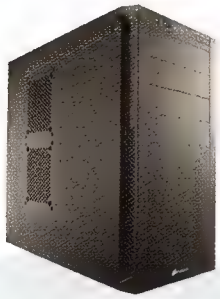
SOLID-STATE DRIVE
Crucial MX100 512GB

Crucial has made a big splash in the SSD market with this chunky drive. The 512GB version is quicker, larger and cheaper than the pricier M550.



CHASSIS
Corsair Carbide 200R

Much more impressive than its price tag may lead you to believe, the clean lines and added extras of this chassis make it the case to beat at under $100. An understated bargain.



SCREEN
AOC I2757Fh

The LED-backlit 27-inch, 1080p IPS display is a couple of years old now, but it was tops to begin with and has therefore stood up well to newer models.

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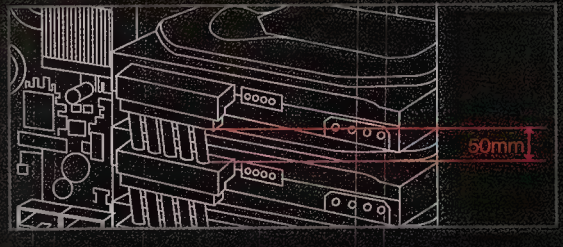
- **MEET 85% EFFICIENCY**
- **+12V SINGLE RAIL**
  Provide strong power to any overloading condition and VGA compatibility.
- **QUIET AND DURABLE COOLING**
  120mm long lasting fan provides superior cooling, noise <19bBA at 50% loading.
- **SATA ARRAY CABLE DESIGN**
  50mm intervals for SATA device installation, to optimize the airflow inside the case and no-hassle with case side panel.



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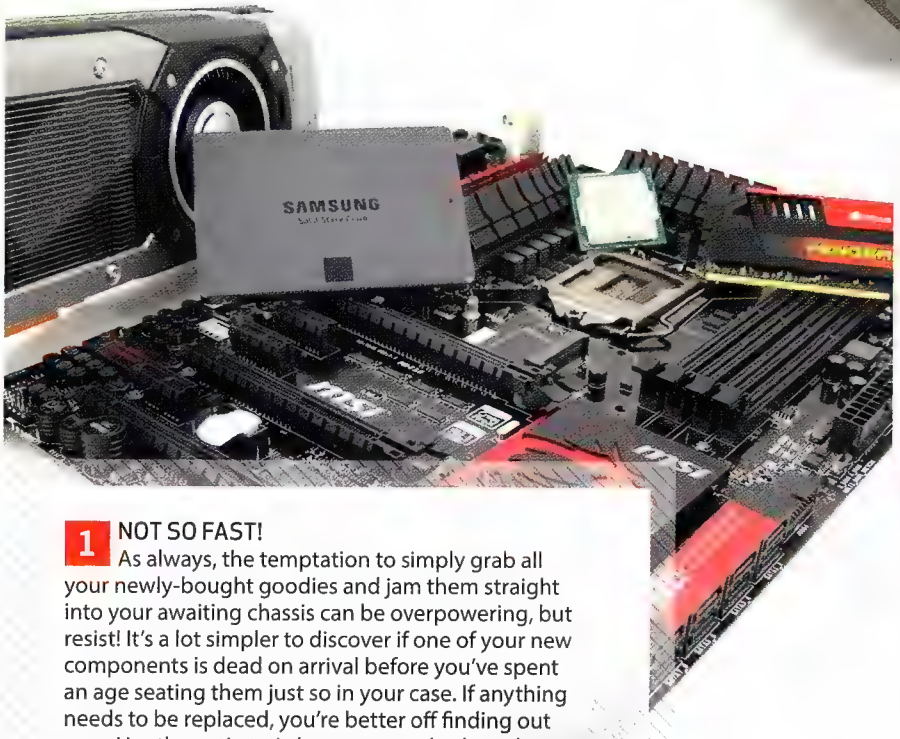
Let's build this thing!

Parts gathered, tools ready, time to get started.

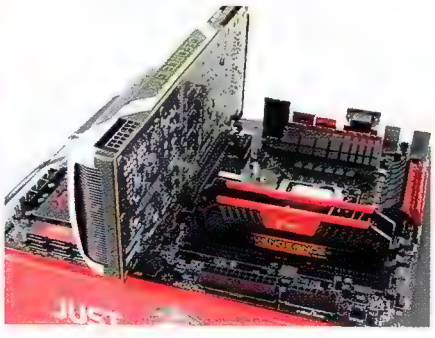
Now it's time to get your hands dirty. Well actually, you don't need to get them dirty at all. Building a rig is a pretty clean process, provided you don't do it in a swamp!

Enough whimsicality though, because you'll need to concentrate for this. Over the next ten steps you'll find a pictorial guide which will help you in the process of piecing your gaming rig together. We've excluded several important steps on the basis that they are very easy. These include: plugging in your mouse and keyboard, turning the computer on, and connecting it to the internet.



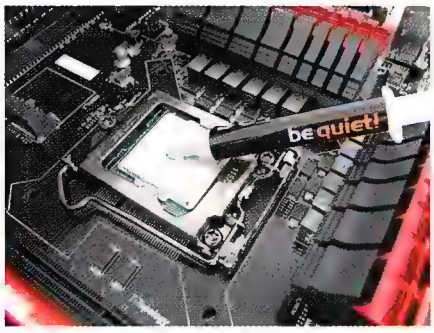
1 NOT SO FAST!

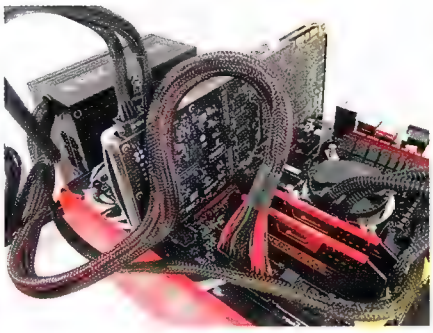
As always, the temptation to simply grab all your newly-bought goodies and jam them straight into your awaiting chassis can be overpowering, but resist! It's a lot simpler to discover if one of your new components is dead on arrival before you've spent an age seating them just so in your case. If anything needs to be replaced, you're better off finding out now. Use the anti-static bag your motherboard came in and rest the board on the bag on top of its box.



2 FIT THE CPU AND RAM

Drop the CPU into the waiting socket and slot the RAM modules into the marked DIMM 1 and DIMM 2 sockets if you're just using a pair of sticks. The DIMM slots should be labelled on the motherboard PCB and you may find your board won't pass POST if they're in the wrong slots, so check the motherboard manual to be doubly sure. With the board on the box, you can also attach the graphics card and seat it snugly in the primary PCIe socket.





3 GET PASTED

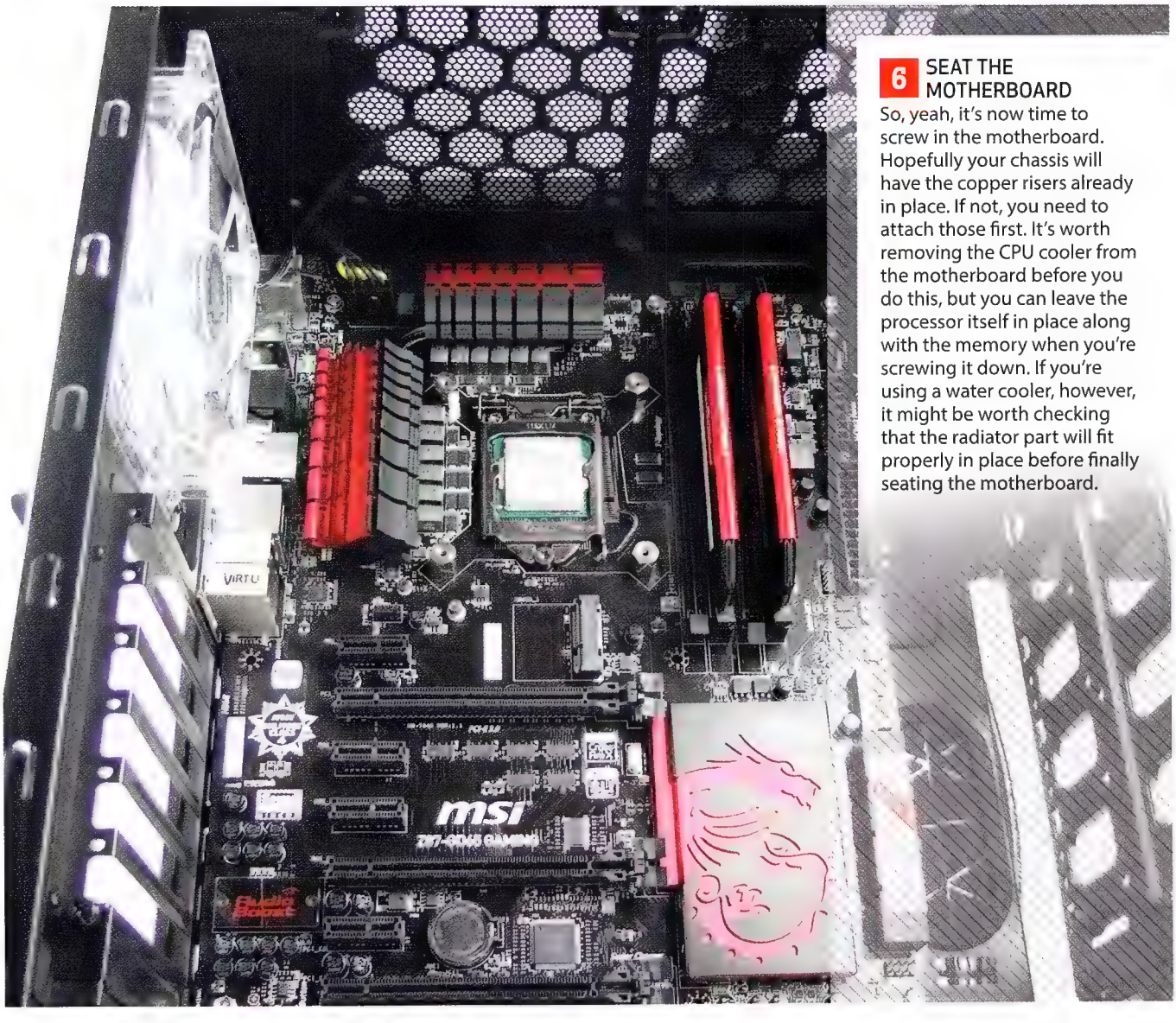
Next you want to attach the cooler to the processor, but first you need some thermal paste to ensure a decent contact. You only really need a blob of thermal goo about the size of a grain of rice, because the CPU plate will spread the paste out when you screw it down. Your cooler will probably come with a one-shot parcel of paste, but if you fancy getting in on the overclocking action, it might be worth buying some more separately.

4 POWER IT UP

With the graphics card in the primary PCIe slot, attach the power cables to both the motherboard and GPU. You don't need to connect the SSD yet because we're just going to check the machine reaches the BIOS stage. Plug your screen into the graphics card, plus a keyboard into the mobo, and power up your bare bones system. If all is well, the monitor will burst into life and you'll be able to get yourself into the BIOS pages. Power down and let's get building properly.

5 FIT THE PSU

We'd recommend starting with the power supply, because it's a lot easier to get the bulky darn thing installed before you fix any other components in place. Get your PSU seated, making sure the intake fan is sucking from the vent in the base of the chassis, and screw it into the case from the rear. Now collect all the cables from the back of the PSU and make sure they're not cluttering up the space inside. You don't want to accidentally screw in the motherboard on top of anything.

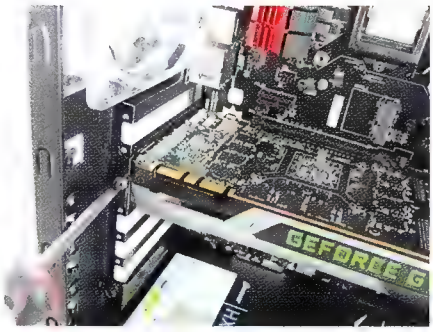


6 SEAT THE MOTHERBOARD

So, yeah, it's now time to screw in the motherboard. Hopefully your chassis will have the copper risers already in place. If not, you need to attach those first. It's worth removing the CPU cooler from the motherboard before you do this, but you can leave the processor itself in place along with the memory when you're screwing it down. If you're using a water cooler, however, it might be worth checking that the radiator part will fit properly in place before finally seating the motherboard.

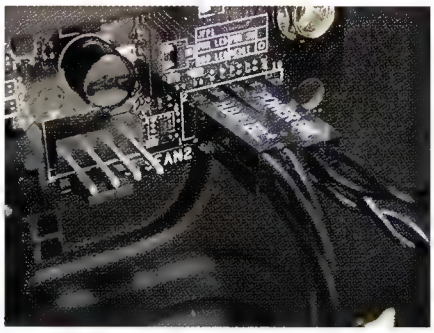
7 INSTALL SOME STORAGE

SSDs are at a stage where you can pick up a drive with enough capacity to fulfil pretty much all your needs without the need for an extra HDD to pick up the slack. This 1TB drive is all we need to start with. Our CM Storm Scout 2 comes with a 2.5-inch adapter tray. Screw your drive into the relevant area in your case and plug the SATA cable into the first SATA 6Gbps connector. You'll also need a SATA power connector from the PSU.



8 FIT YOUR GRAPHICS CARD

We're getting mighty close to the end now, so it's time to slot in the sexiest component of the lot — your new graphics card. It's also probably the chunkiest of the components, after the PSU brick, which is why we've left it until towards the end of the build. Ensure it's seated firmly in the primary PCIe slot and screw it into the chassis to stop it from moving around or rattling. It's worth making sure there are no cables obstructing its fans.

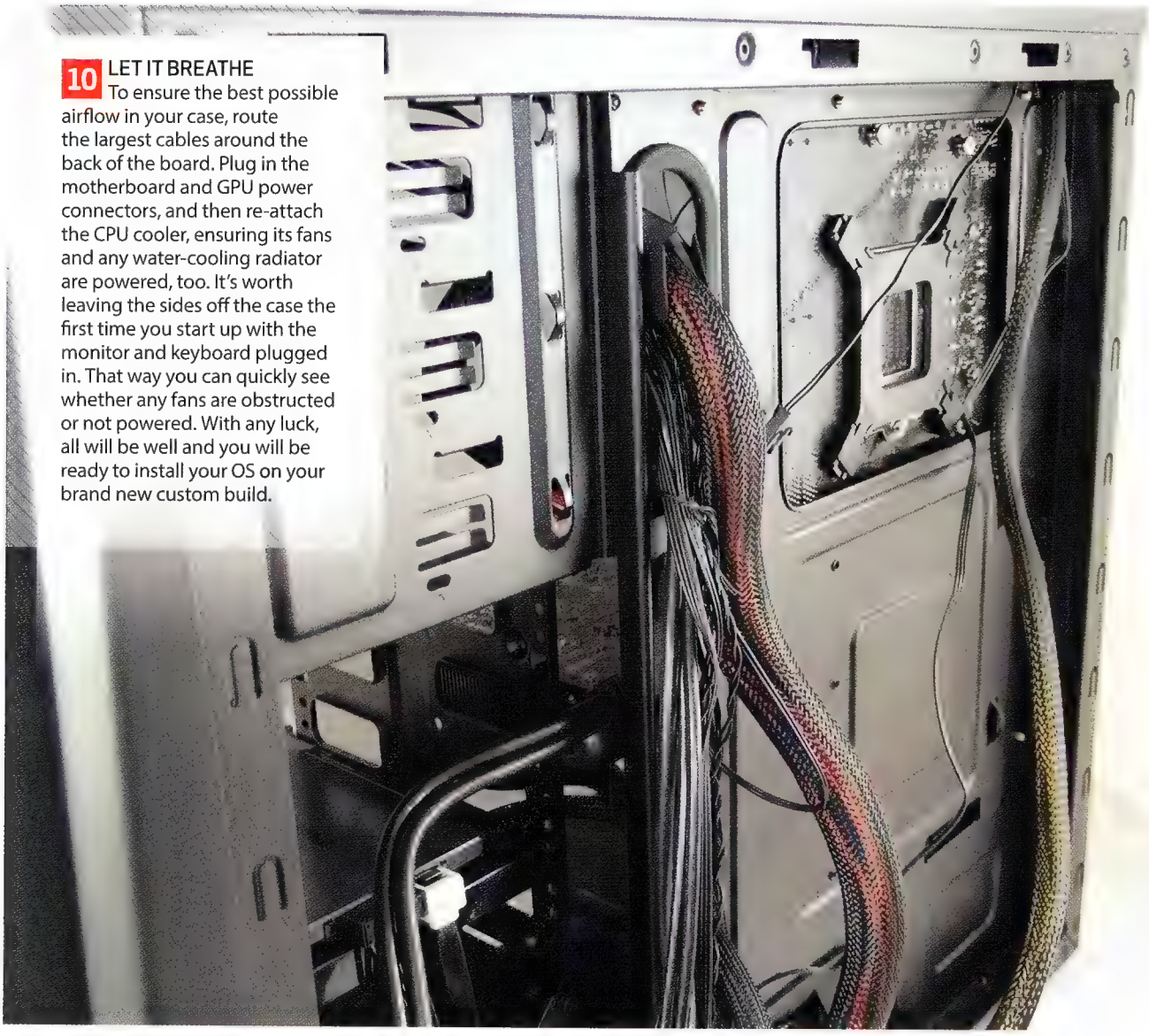


9 CHECK YOUR CABLES

Now it's time to start plugging everything back in. First things first though — get the chassis' controls and hubs plugged into the motherboard. We've often put a build together, forgotten this simple step and wondered why we couldn't power up. Again, your motherboard will have a key to show which front panel cable goes where. Plug in the control and lighting cables, as well as any USB 2.0 or 3.0 hubs and audio connectors.

10 LET IT BREATHE

To ensure the best possible airflow in your case, route the largest cables around the back of the board. Plug in the motherboard and GPU power connectors, and then re-attach the CPU cooler, ensuring its fans and any water-cooling radiator are powered, too. It's worth leaving the sides off the case the first time you start up with the monitor and keyboard plugged in. That way you can quickly see whether any fans are obstructed or not powered. With any luck, all will be well and you will be ready to install your OS on your brand new custom build.



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- Features the X-Celerator, a single-axis analog thumb paddle forged for modern battlefields.
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ROCCAT Kave XTD Stereo – Premium Stereo Gaming Headset

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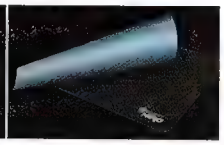

ROCCAT Hiro – 3D Supremacy Surface Gaming Mousepad

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Sapphire Tri-X R9 290 TRI-X 4GB GDDR5 OC

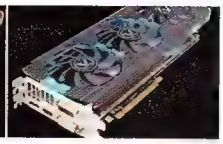
STAY COOL AND QUIET.

Sapphire Tri-X R9 290 4GB OC has 250 stream processing units, 1,000MHz engine clock, 4GB GDDR5 memory, 512-bit interface and is clocked at 5,200MHz effective. It is cooled with latest Tri-X cooling technology, powered by three fans with dust repelling bearings, and aerofoil section blades to deliver highly efficient airflow at low noise.

- Support for Ultra HD (4K displays)
- Tri-X cooling technology
- Sapphire PCB design, 6-phase VDDC power

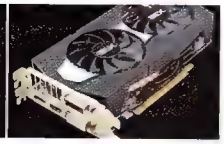
ALSO FROM SAPPHIRE

Tri-X R9 290X 4GB GDDR5 OC



Vapor-X R9 280X 3GB GDDR5 Tri-X with boost

Dual-X R9 270X 4GB GDDR5



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Thermaltake blasted onto the high-end PC cooling scene this year with its ground-breaking LCS (Liquid Cooling Systems) Pacific range, offering enthusiasts and gamers an incredibly robust and powerful set of liquid cooling components. It's easier than you think to put together – and delivers outstanding cooling for your entire system.

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- Near silent operation
- Rising LED fan compatible

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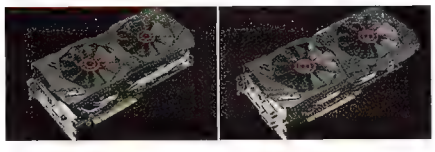
SILENT GAMING WITH PERFORMANCE!

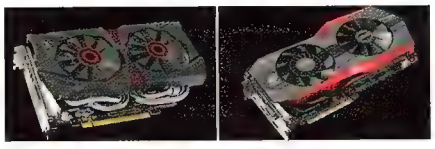
Based on the NVIDIA second generation Maxwell core architecture, the STRIX GTX 960 delivers immersive graphics for a great gaming experience. Featuring a factory-overclocked core with an OC boost frequency of 1317MHz and 0dB fan technology paired with the renowned DirectCU II heatsink design. Game on with STRIX GTX 960!

- 1291MHz factory-overclocked core with 1317MHz boost clock in OC mode
- DirectCU II with 0dB fan technology for silent gaming under light load, while 30% cooler and 3X-quieter during hardcore gaming
- GPU Tweak with XSplit Gamecaster allows for easy overclocking and gameplay streaming

ALSO FROM ASUS



STRIX GTX 980 | STRIX GTX 970



STRIX GTX 960 4GB | ROG Matrix Platinum GTX 980

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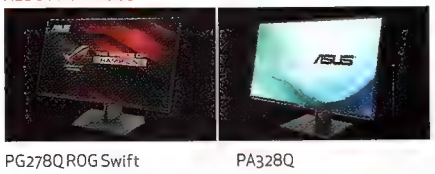
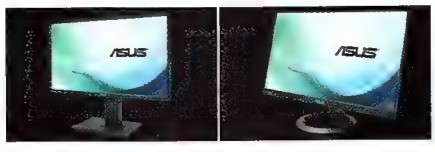
- 27-inch form factor using In-Plane Switching technology panel supporting WQHD 2,560 x 1,440 resolution with 60Hz refresh rate and 178° wide-viewing angles
- Brushed aluminium design aesthetics awarded 2015 iF Design Award, thin 5.5mm black matrix with 0.8mm bezel and audio co-developed with Bang & Olufsen

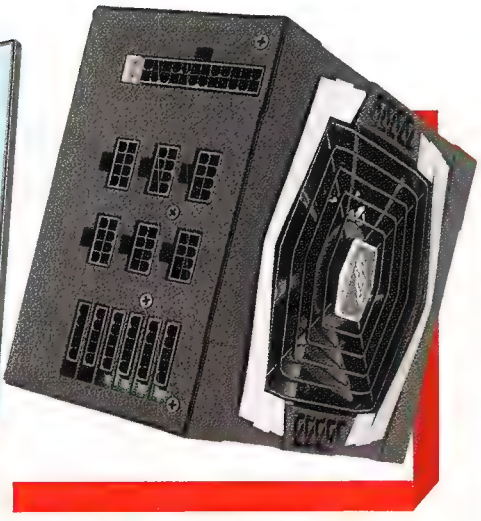
ALSO FROM ASUS



PG278Q ROG Swift | PA328Q



PB279Q | VX24AH



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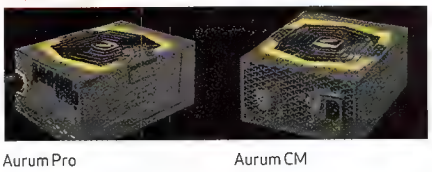
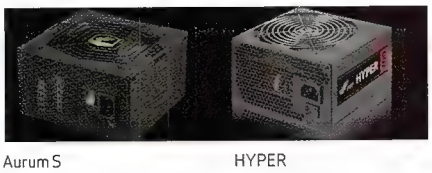
- High wattages with 80PLUS Platinum Certification
- Full modular with soft cables
- Full Japanese capacitors and solid capacitors

ALSO FROM FSP



Aurum Pro | Aurum CM



Aurum S | HYPER

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FSP
POWER NEVER ENDS

Benchmark your CPU

Benchmarking your processor, RAM and motherboard is a valuable endeavour for a number of reasons. The most obvious one is that it gives you an excellent overview of how well your PC is performing.

It's convenient too, as rather than having to run lots of different tests, or use your PC in certain ways to gauge how it performs, most benchmarks run a range of intensive tests that push your hardware as far as it goes, as well as replicating real world use. It means you can leave the benchmarks to run unattended while you go and do something more productive (or, let's face it, just listlessly browse the internet). Benchmarks from reputable companies do push your hardware to the limits, but they'll always be safe, so you won't have to worry about damaging your kit.

Once the benchmarks have finished you're usually given a report that outlines how your hardware performed. These reports usually lay out the information in an easy to understand way (and even sometimes come with fancy charts), meaning you can avoid having to pore over pages of confusing stats.

1 BENCHMARK FOR TROUBLESHOOTING

This leads us to another reason why you'd want to benchmark your CPU, RAM or motherboard; troubleshooting. If your PC isn't behaving the way it's supposed to, benchmarking your hardware is an excellent way to pinpoint what the problem might be. The test results could point to a bit of hardware that is struggling which could be holding your PC back. If the benchmark fails, or causes your PC to crash, during a particular test, this is also a great way of finding out what's wrong with your machine. If you've recently built your PC it's a good idea to run intensive benchmarks for a couple of hours (if not more) to make sure your build is stable.

2 GET STARTED

The first thing you'll need to do is to download the benchmark program you want to use. There are plenty of tools available on the internet and many concentrate on benchmarking specific hardware. Because we want a benchmark that covers both CPU and RAM (amongst other things), we're going to go for NovaBench. You can download it from **https://novabench.com** (image A).

» Once downloaded all you need to do is launch NovaBench and click on 'Start Benchmark Tests' (image B) to begin running all of the tests in the NovaBench suite. If you don't want to run all of the tests, but would rather just run specific tests on a select set of hardware, click the 'Tests' option on the menu bar.

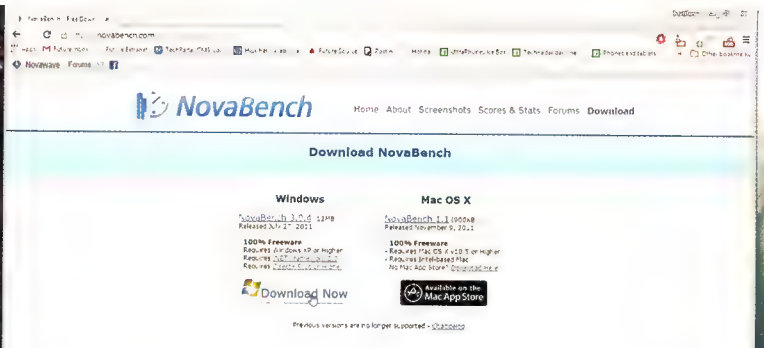
A drop down menu will appear giving you various options to run specific tests. This is handy if you don't have time to run the full range of tests, or if you want to avoid benchmarking specific hardware for the time being.

To get the best results when benchmarking it is good practise to close any applications that are currently running. Thankfully NovaBench will remind you to close any open programs before the benchmark tests begin. A helpful window appears listing all programs that are currently open. Once they are closed, click 'Proceed' to continue with the tests.

As the benchmark tests run, leave your computer alone. A number of windows will pop up as the tests complete. Once completed a new window will pop up displaying your results.

Running NovaBench gives you an overall score which for the moment won't mean a lot, though the higher the score, the better your hardware is at performing. Underneath the main score you get a quick overview of your PC including the operating system, processor and graphics card.

A

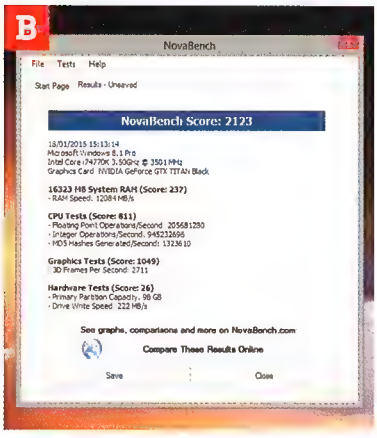


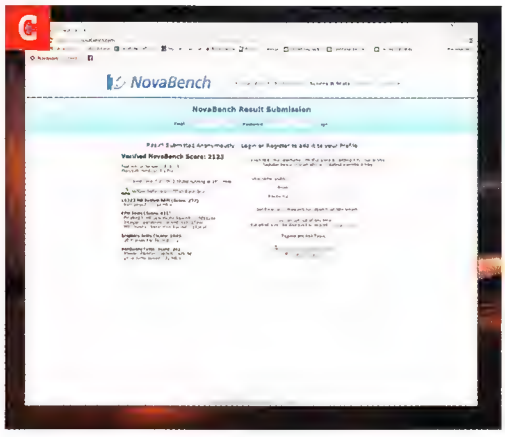
3 UNDERSTANDING YOUR RESULTS

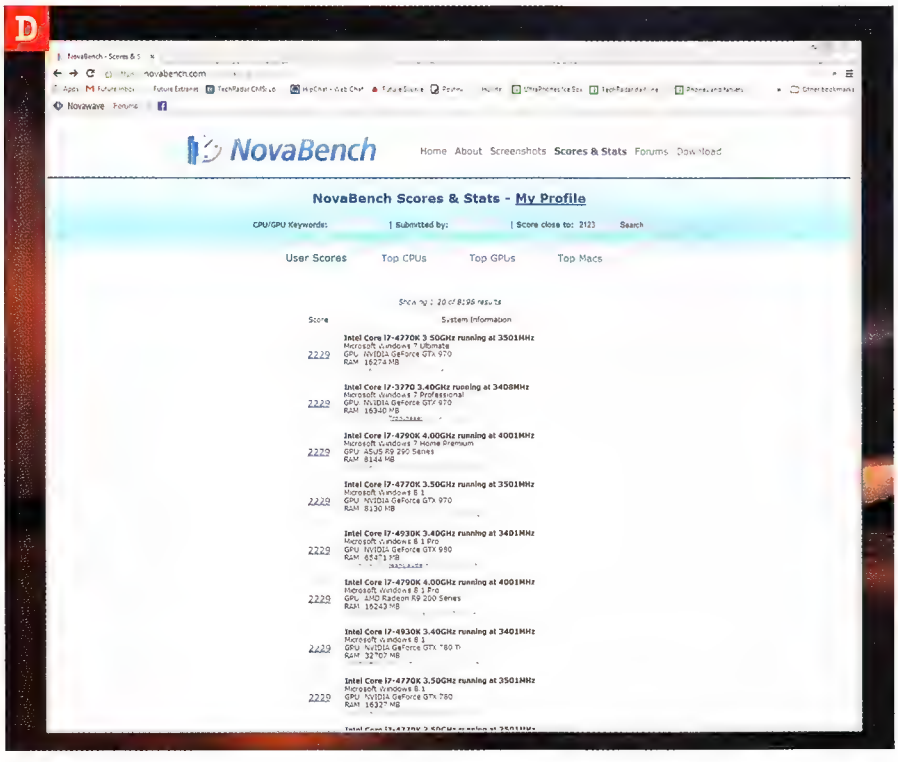
The results of the NovaBench benchmarks are broken down into RAM, CPU Tests, Graphics and Hardware tests. Each section gets its own score along with more detailed results. For example the RAM section will give you the results of the speeds of your RAM (image C). There is an option to save your results which is helpful if you're planning on upgrading any parts of your PC. You should run the benchmark again after your changes and compare the results with the saved report from before your upgrades, letting you see how much of an improvement you've made.

Perhaps the most useful part of the results page is the ability to compare your results online. Click 'Compare These Results Online' . You'll be taken to a page where you can sign up to NovaBench and create a profile with your results (image D). If you'd rather not sign up, or want your scores to be anonymous, simply click the 'Keep this score anonymous' at the bottom of the page.

The next page will show you your results alongside a chart that compares your results with the three month average. If you're proud of your score and want to crow about it, there are a number of links to let you easily share your score on social media. Click 'Find similar score' to see results that are similar to yours and the hardware that scored those results. If your score is around the same as less powerful machines, there may be a problem with your machine. You can also check out higher scores to see what hardware you may want to upgrade to later on.






D
NovaBench
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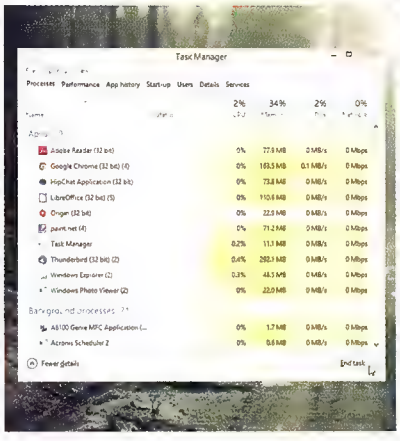
IMPROVE YOUR SCORE

Not satisfied with the benchmark results? Then there are a few things you can do to improve your score without resorting to buying or overclocking your hardware. To begin with you should ensure that your PC is in as good a condition as possible before running the benchmark tests. This means scanning your PC for any viruses or malware that could impact the performance.

Once you're sure that your PC is clean make sure that all critical updates for your operating system are installed and up to date. Once done make sure all the drivers for your hardware are installed and up to date as well. After that restart your computer and wait two minutes for all the start up programs and services to launch.

Next you should make sure that all unnecessary programs are closed down. Don't simply close any open windows; you'll need to go deeper to get the best results. First of all make sure that all the programs in the notification area of the taskbar (just to the left of the date and time) are closed down. Finally open up the task manager by pressing Ctrl-Shift-Esc and close down any Apps or background processes by clicking on them and selecting 'End task'. Now wait a while for everything to close and then re-run the benchmarks.



The Task Manager is a great tool for closing background programs.

Push your GPU to the limits with the Heaven benchmark.

Benchmark your GPU

There's a certain panic many PC gamers will be well acquainted with. A brand new game is coming out with stunning graphics and you can't wait to play it. But then the fear sets in; will your PC be capable of running it?

This is where benchmarking your GPU comes in. It's a great way to quickly and easily see how well your graphics card will cope with a variety of graphical demands and effects. A good graphics card benchmark will put your GPU through its paces, and the results will paint a good picture of what your GPU can and can't do well.

With these results you can then look at tweaking the game settings so that you might sacrifice some graphical bells and whistles, but you'll get a smooth and playable frame rate as a result.

If you've just bought a beast of a graphics card then benchmarking it (and the high scores it produces) can give you bragging rights over your friends, and that's always nice.

1 WHY BENCHMARK?

Because GPU benchmarks throw a number of intensive graphical tests at your GPU, it's a great way to see how your graphics card performs under load. If you've built your own rig, or overclocked your graphics card to eke out more performance, than running a benchmark for a few hours can give you confidence that your GPU is stable. The last thing you want in the middle of a game is for your graphics card to fail, so running benchmarks can catch any problems early on. If it can run them for hours on end without problem you're good to go. If there are crashes, artefacts or other graphical glitches then you can begin working out what the problem is. One of the most likely culprits will be a GPU getting too hot, so if your graphics card fails to run a benchmark, it might be worth making sure it's getting plenty of cool air.

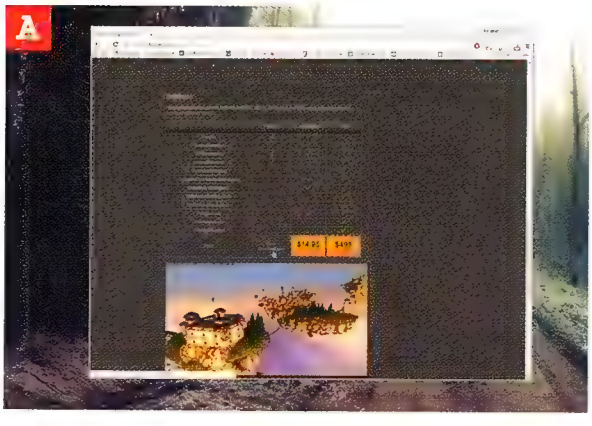
2 HOW TO BENCHMARK

When it comes to choosing software to benchmark your graphics card you're spoiled for choice. There are a number of popular benchmarking suites available that can put your graphics card through its paces. Not all of them are free, however, such as the popular 3DMark benchmark. There is a free version (**www.3dmark.com**) but the options are limited.

» For a free version which still comes with enough settings to properly test out your graphics card we'd recommend going for Heaven Benchmark, which can be downloaded from **unigine.com/products/heaven** (Image A). Scroll down the page until you see 'Download now'. Click the link, and then select where you want to download it from.

» Once installed, run the program. A window will appear (Image B) letting you select various options, such as the texture quality and the resolution you want the benchmark to run at. When choosing the resolution it's best to run the benchmark at the resolution you usually run games. That's the resolution you run Windows in as well (such as 1,920 x 1,080), then select 'System'. If you fancy testing out how well your gaming rig will cope with stereo 3D such as Nvidia 3D vision, you can enable 3D as well. If the benchmark runs well without any crashes or major framerate drops then you're good to grab a pair of 3D glasses and get gaming.

» If you're not sure about what settings to use, there are a couple of ready made presets that will help you get benchmarking quickly and easily. Next to where it says 'Presets' click the drop down box and choose either 'Basic' or 'Extreme'. As you can guess, Extreme will really push your graphics cards to the limit. Will your GPU be up to the task? When ready press 'Run' to begin the benchmark.



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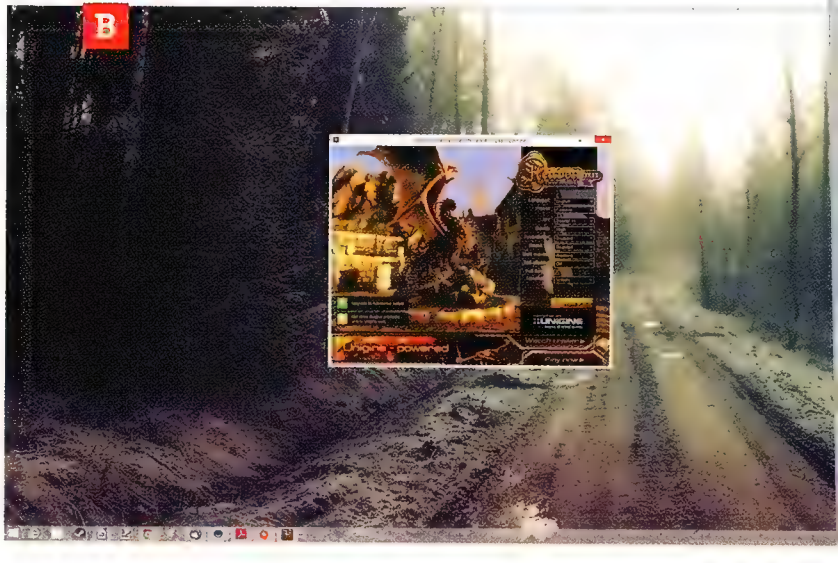


B

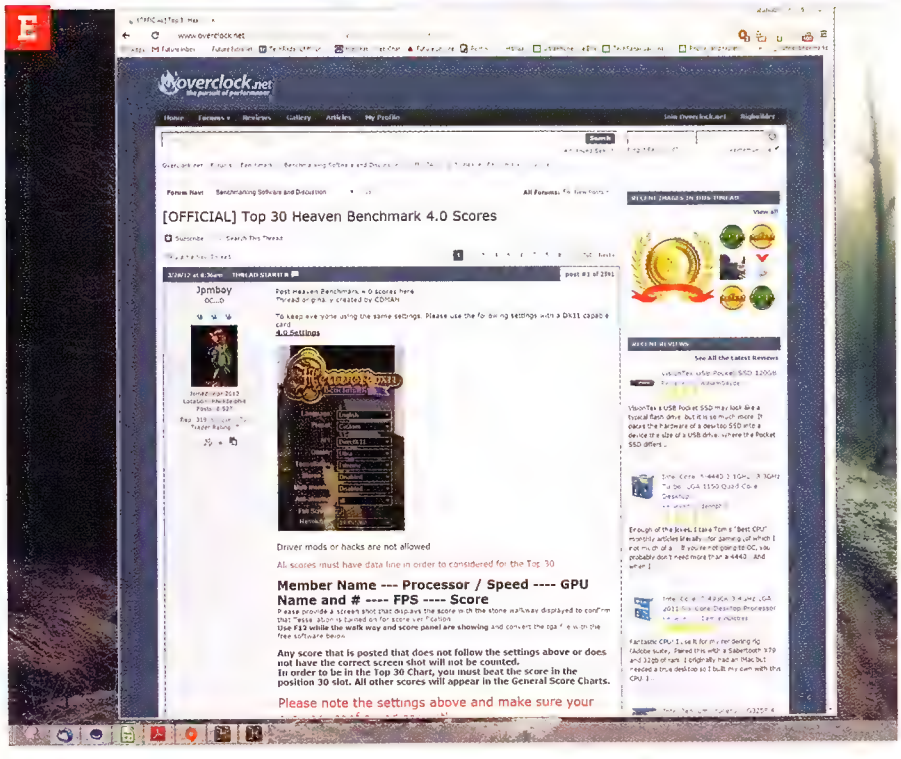
3 BENCHMARK RESULTS

When the Heaven benchmark runs you'll see a number of attractive 3D environments with the camera panning over them. This is a handy way to see how well your GPU handles this level of graphics. Just with your eyes you should be able to make out any dropped frames, graphical glitches or tearing.

» If the benchmark doesn't run smoothly then you already know that your graphics card is going to struggle with certain graphics. On the top right-hand corner of the screen you'll see an FPS (frames per second) counter which gives you a lot more information (Image C). For a smooth gameplay experience you'll want that counter to sit around at least 30. Any drops below can result in your games feeling slow and choppy. The higher this score the better, and ideally you'd like to see it at 60FPS. If your graphics card is struggling here, try changing the settings in the Heaven Benchmark settings page.

» This area will also tell you about your GPU including the model and memory. It will also record the temperature of your GPU — pay close attention to this as high temperatures can mean your GPU is struggling. An overheating GPU can also lead to problems and system instability.

» To begin recording the results of the benchmark, click 'Benchmark' on the top-left hand side of the screen or press F9 on the keyboard. Heaven will now run a number of tests and then display your results in a new window (image D). These results with give you your average, min and max frames per seconds along with a score. The higher the score, the better. There's no quick way to compare scores with other people, but there are plenty of web sites such as **www.techpowerup.com** and **www.overclock.net** that feature message boards dedicated to discussing Heaven benchmark results (image E).

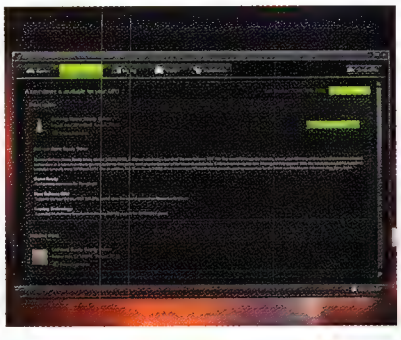

E
overclock.net
[OFFICIAL] Top 30 Heaven Benchmark 4.0 Scores
Jpmboy
Driver mods or hacks are not allowed
All scores must have data line in order to considered for the Top 30
Member Name --- Processor / Speed ---- GPU Name and # ---- FPS ---- Score
Any score that is posted that does not follow the settings above or does not have the correct screen shot will not be counted.
In order to be in the Top 30 Chart, you must beat the score in the position 30 slot. All other scores will appear in the General Score Charts.
Please note the settings above and make sure your

WHAT MIGHT IMPROVE IT?

If your graphics card isn't getting the score you hoped for, there are a number of things you can do to improve the score before you resort to ripping out your GPU and replacing it with a newer model.

First of all you should make sure have the latest stable drivers installed for your graphics card. You can check this by either going to the web site of your graphics card manufacturer, or using a program such as GeForce Experience (**tinyurl.com/o4oqdng**) for Nvidia cards to check that you're running the latest drivers. If you are using experimental or beta drivers it might be worth rolling back to the last official stable release. Once done restart your computer and wait two minutes for all the start up programs and services to launch.

Close down any open programs once Windows has restarted and re-run the benchmarks. If you're still not happy, there might be another reason for the issues. Try opening up your PC and make sure that it is dust free and well ventilated, as overheating graphics cards could be the cause of poor performance and low benchmark scores. Clean the insides carefully with compressed air and a light brush. If that doesn't work, upgrade! ■



Nvidia Gefore Experience is a handy tool for keeping your graphics drivers up to date.

Benchmark your storage

Hard drives are one of the most important parts of your PC.

Not only do they store all of your important files, but they also have a huge impact on how your computer performs. Having a speedy and healthy hard drive with Windows installed can cut your boot times down drastically, while installing games on a super fast SSD will mean more time playing and less time staring at a loading screen. Benchmark testing can help you determine how fast your hard drives are, and if you have multiple disks in your rig, it can show you which one is the fastest, giving you a better idea of which drive you should install your software on.

Because hard drives are so important, benchmarking is also an excellent way of making sure your drives are healthy. A hard drive that can't complete the benchmark, or has seriously low results, could be failing. This will give you a decent heads up to start backing up your files in case the drive fails completely.

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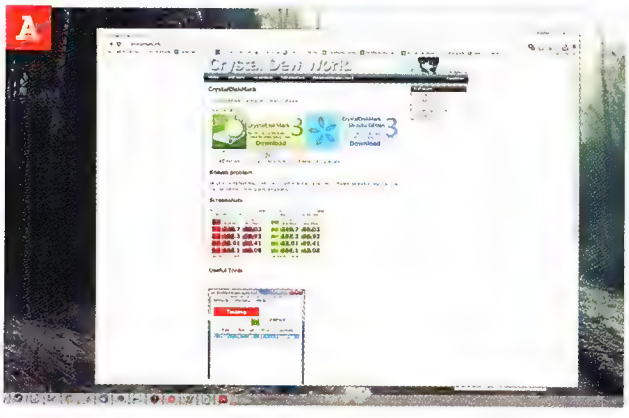

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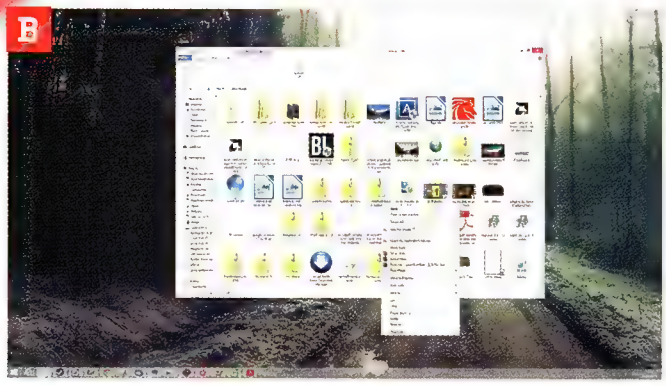


1 EXTERNAL HARD DRIVES

The main metric hard drive and storage benchmarks measure is speed. The faster your hard drive reads and writes, the faster tasks such as loading Windows, running programs and copying and pasting documents and files become. You don't just have to benchmark hard drives, as most benchmark suites will be able to test external hard drives and USB memory sticks as well. This is good for checking how well your devices are running. It's also handy for checking out your ports. If you plug in a USB 3.0 device into a USB 2.0 port and run the test, then plug it in to a USB 3.0 port and rerun the benchmarks you should see quite a difference in results.

2 HOW WOULD YOU BENCHMARK?

There are a number of hard drive benchmark tools available, and because there are only a certain number of ways you can test your drives, a lot of them offer very similar tools and features. This means it is largely up to your own personal tastes which benchmarks you go for. A word of warning though; some methods of benchmarking require you to format the storage you want to test. You won't be able to wipe the drive you're running Windows on, but you could accidentally wipe an important hard drive!

» Even with tests that don't require you to format your drives first, you should make sure you back up any important files on the drive you're testing. By their very nature benchmarks put your hardware though incredibly tough tests that will stress your devices to their limits. If a hard drive or USB stick is already failing — or about to fail — it could mean your data is lost if something goes wrong.

» A lot of hard drive benchmark tools offer a range of indepth results that can be baffling at first. This is why we recommend CrystalDiskMark, as it offers a range of tests and presents the results in an easy to understand manner. To download CrystalDiskMark go to **crystalmark.info/software/CrystalDiskMark/index-e.html** and click 'Download' (Image A). The next page will give you a lot of options. Make sure you download the standard version of CrystalDiskMark. There will also be links to CrystalDiskInfo. This is a different program that gives you indepth information about your drives. It's a handy tool, but won't benchmark your drives.

» Once downloaded right-click on the compressed Zip folder and select 'Extract All'. Once done open up the newly created folder and run DiskMarkX64 (if you're running a 64-bit PC, if not just select DiskMark).

3 BENCHMARKS AND RESULTS

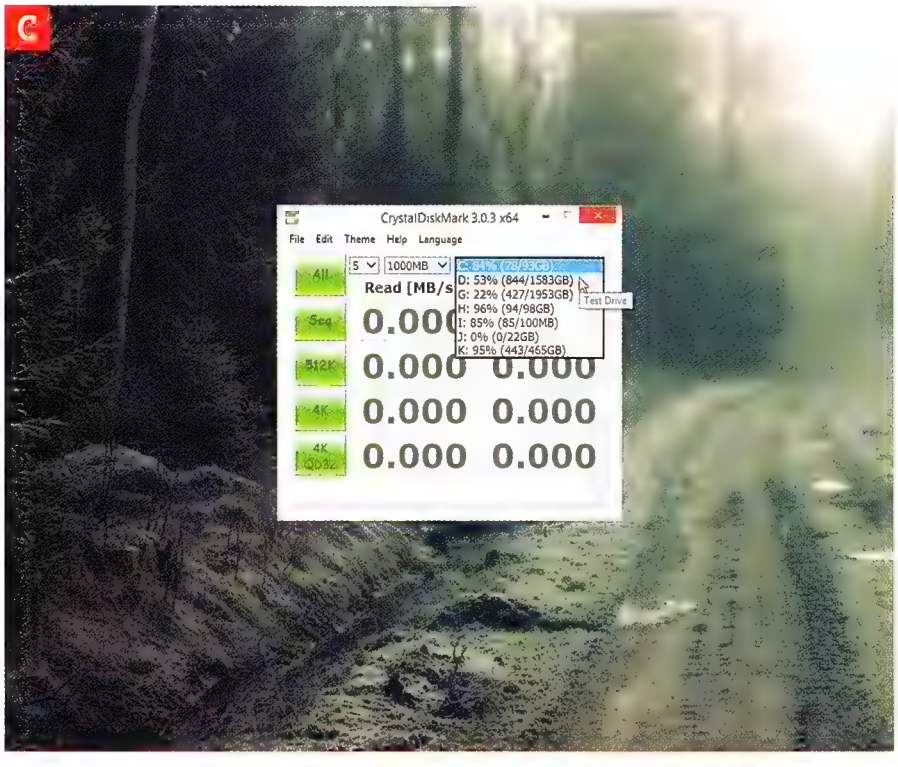
Once CrystalDiskMark launches you can begin tailoring your benchmarks. On the top-right hand side of the window will be a drop down list box with your C: drive selected. Clicking this drop down menu will show you all your drives, letting you select the one you want to test (Image C). To the left of that box is another drop down list that lets you select the size of the test files you want to use. If you usually work with smaller files, then selecting 100MB or below might give you more accurate scores. However if you often move large files, such as high definition video files, then choosing a larger file size will be a good choice. For most people it's worth keeping this setting as default.

» To the left of that list is a drop down list that will determine how many times the tests will be run. The default is 5. The more tests you run the more accurate averages you'll get, though the benchmark will take longer to run. If you want to stress test your hard drives, put the number up to 9.

» Along the left-hand side are five green buttons. The All button (image D) will run all the tests. 'Seq' will just run the sequential read and write tests. '512K' will just run random large operations one at a time. '4K' will run small operations one at a time, and finally '4KQD32' will run small operations, but many at one time.

» For our tests we'll run 'All'. Once begun you can cancel the tests at any time by clicking 'Stop'. As the tests complete you'll see the results in both Read and Write (Image E). The results are presented in MB/s, and the higher the number, the faster your hard drive is. You'll most likely see a big difference between read and write results, as hard drives usually read data on them much faster than they write data.

C



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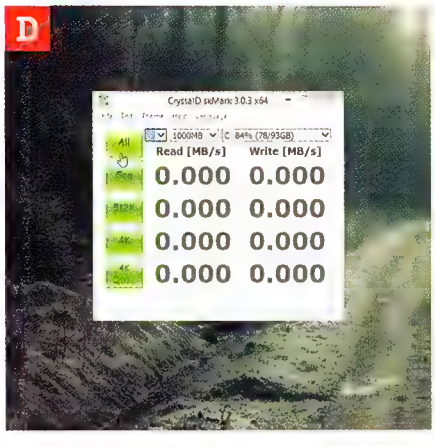

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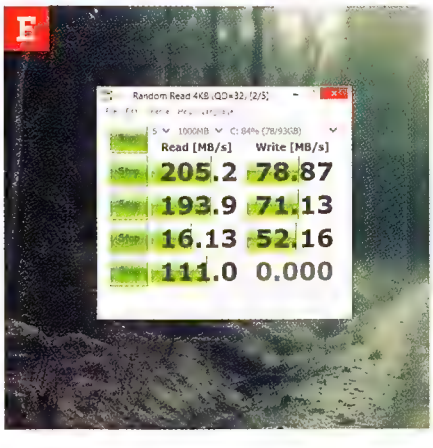
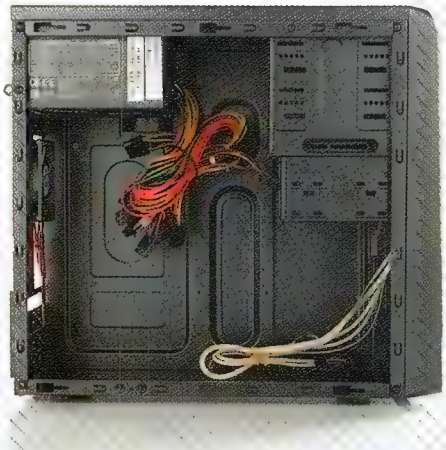


WHAT CAN IMPROVE YOUR SCORE?

There are a number of ways you can improve the benchmark scores without having to upgrade your hardware. First of all, make sure that no additional programs are running — especially if programs are running on the hard drive you're testing. You can close down all open programs by opening up the Task Manager by pressing Ctrl-Shift-Esc and clicking each program and selecting 'End Task'. You'll also want to make sure your virus protection is paused, as this continually uses your hard drives and can cause the benchmarks to show slower results.

Benchmarks take time, but while they are running don't be tempted to use your PC to browse the internet or play games, as this will impact on your benchmark results as well. If you're still getting poor scores, try inserting your storage into a different port. For USB 3.0 devices, make sure it's inserted into a USB 3.0 port and that all drivers are updated.

You can also change the SATA ports your hard drives are inserted into, but that will require you opening up your PC. Some SSDs and motherboards support the faster SATA III ports, so make sure they are correctly installed. Your motherboard's manual should have a diagram showing you which SATA ports will give you the most efficient rates of throughput.



Making sure your hard drive is inserted into the correct SATA port could make a big difference.

NEXT-GEN TECH PREVIEW

With so much new kit to cram into 12 months, it's going to be one jam-packed year. Dave James reveals some of the highlights...

Have you seen the price of crystal balls recently? They're super-expensive. Obviously fortune tellers have vast sums of money from their numerous lottery wins to call on, but us tech journalists don't have such resources to fall back on. No, we need to do research, ask questions and investigate, all in order to figure out what's going to happen over the next year or so. Not like those feckless fairground rich-kid psychics...

On the surface of it though, predicting what's coming up for the rabid technorati in 2015 should be pretty simple. There'll be new, quicker processors, faster graphics cards, laptops with longer-lasting batteries and screens with more pixels than stars in the night sky. Digging into the specifics though is a mite trickier, and more difficult still is to figure out the motivations and unspoken intimations behind what's going on with new releases.

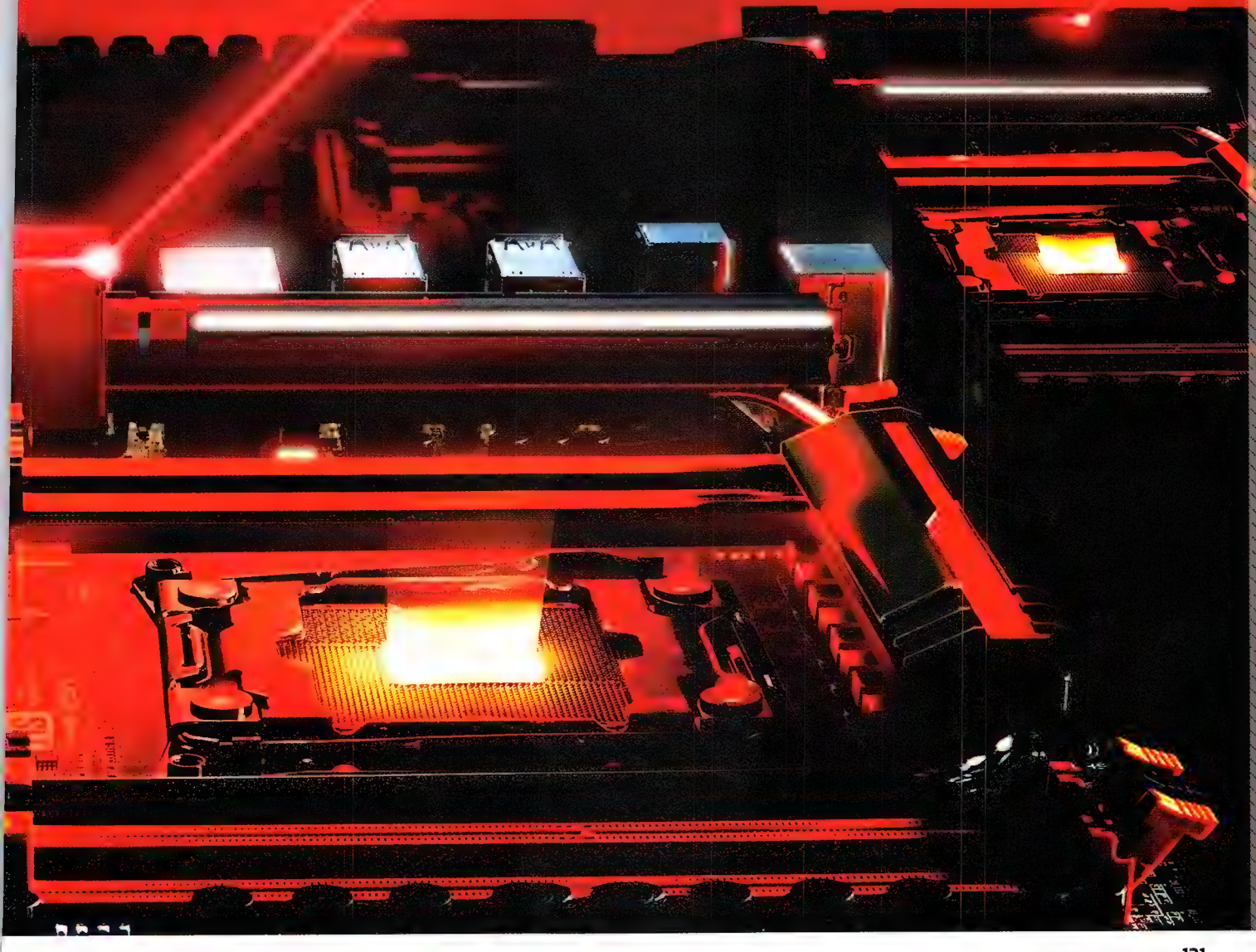
There are also areas where we may not have expected much progress, let alone anything new or even interesting. Things like the sudden resurgence of virtual reality as a tangible product, evolving from being purely about a single tantalising device into an increasingly crowded future marketplace.

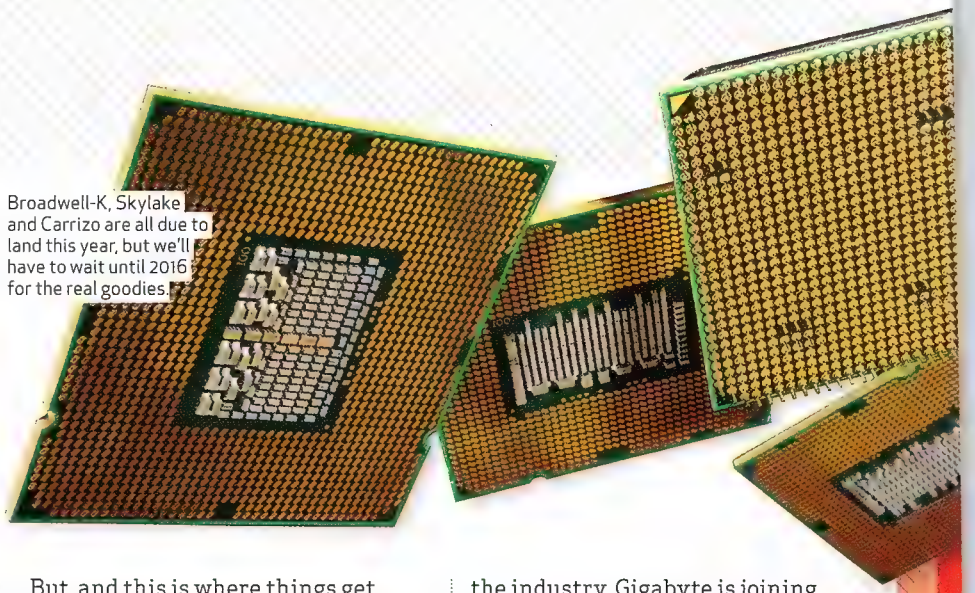
We're also seeing tech being born entirely from burgeoning past-times, like game streaming, coming to the fore too. So while there will certainly be the usual suspects releasing iterative updates of their previous generations, there will also be a huge amount of innovation coming over the next year.

And this is all vital stuff for us PC folk too. We're the fixers, the upgraders, and we need to know when, and indeed if, we should be looking for that next major PC update. Should we stick with our current CPU for the next 12 months, for example? Install some new release now or wait for something better to arrive in the summer?

Picking the right time to upgrade is a perennial struggle for the PC builder – there's always something new on the near horizon – but fearlessly spending big on the 'new thing' can be a huge waste when the 'newer thing' comes out only a month later.

So what are we waiting for? Let's dive headfirst into the rest of 2015 and figure out what's going to be on the wishlist for this year's perfect PC.





Broadwell-K, Skylake and Carrizo are all due to land this year, but we'll have to wait until 2016 for the real goodies.

INTEL PROCESSORS

THE SILICON GIANT HAS GOT A CHIP-PACKED YEAR ON ITS HANDS. MAYBE A LITTLE TOO TIGHTLY PACKED...

The next 12 months are going to be big for Intel. There are two huge desktop launches coming this year, one a process shrink down to 14nm with the socketed Broadwell chips and the next a new microarchitecture to take that die-shrink even further with Skylake. Having two new processor generations, the fifth- and sixth-gen core architectures, both arriving in 2015 is a bit odd, and shows how delayed the Broadwell die-shrink has been in the final reckoning.

Intel though will tell you it launched Broadwell in 2014, but for us the Core M simply isn't the Broadwell processor we've been waiting for. No, Broadwell proper isn't due to arrive until 'mid-2015' according to a presentation we had around the release of the latest low-power mobile U-series chips. So we're waiting until mid-year for both the quad-core 14nm laptop chips and the K-series socketed desktop parts to go in our waiting Z97 motherboards.

But, and this is where things get complicated, we're also expecting Skylake processors to arrive around then. Speaking with motherboard manufacturers, they've been prepping to release their new Skylake mobos, the Z170s, at Computex in June. These aren't backwards compatible as they're pinned specifically for Skylake processors and some will be rocking DDR4 compatibility.

DOUBLE TROUBLE

So yes, this all means we ought to be getting sixth-gen desktop chips around the same time as Broadwell-K parts go on sale. Sadly, that points to overclockable K-series Skylake chips being held back until next year, along with the beefy 14nm Broadwell-E chips too.

Speaking of those Extreme Edition chips, it looks like we'll be getting new LGA 2011-compatible sockets from mobo manufacturers soon. After ASUS's bespoke OC Socket on its X99 range surprised the industry, Gigabyte is joining in with its own 2,038-pin socket, taking advantage of some extra voltage control and DDR4 overclocking capabilities.

Stepping outside of the capacious innards of your PC box though, Intel is also preparing an intriguing little Bay Trail-powered device to launch this year – the Compute Stick. Packing a Z3735F chip into a design that's only four inches long, the Compute Stick is a super-tiny PC that you plug directly into an HDMI port to turn almost any display into a PC. The $150 device comes with Windows 8.1, 2GB RAM and 32GB of solid-state storage. Because the Bay Trail chips are the first Atoms to come with proper Intel HD Graphics, it could be a fine game-streaming device indeed.

AMD PROCESSORS

NEW APUS ARE NOT TO BE CONFUSED WITH SPICEY SPANISH SAUSAGE OR GINGER STARS OF NYPD BLUE

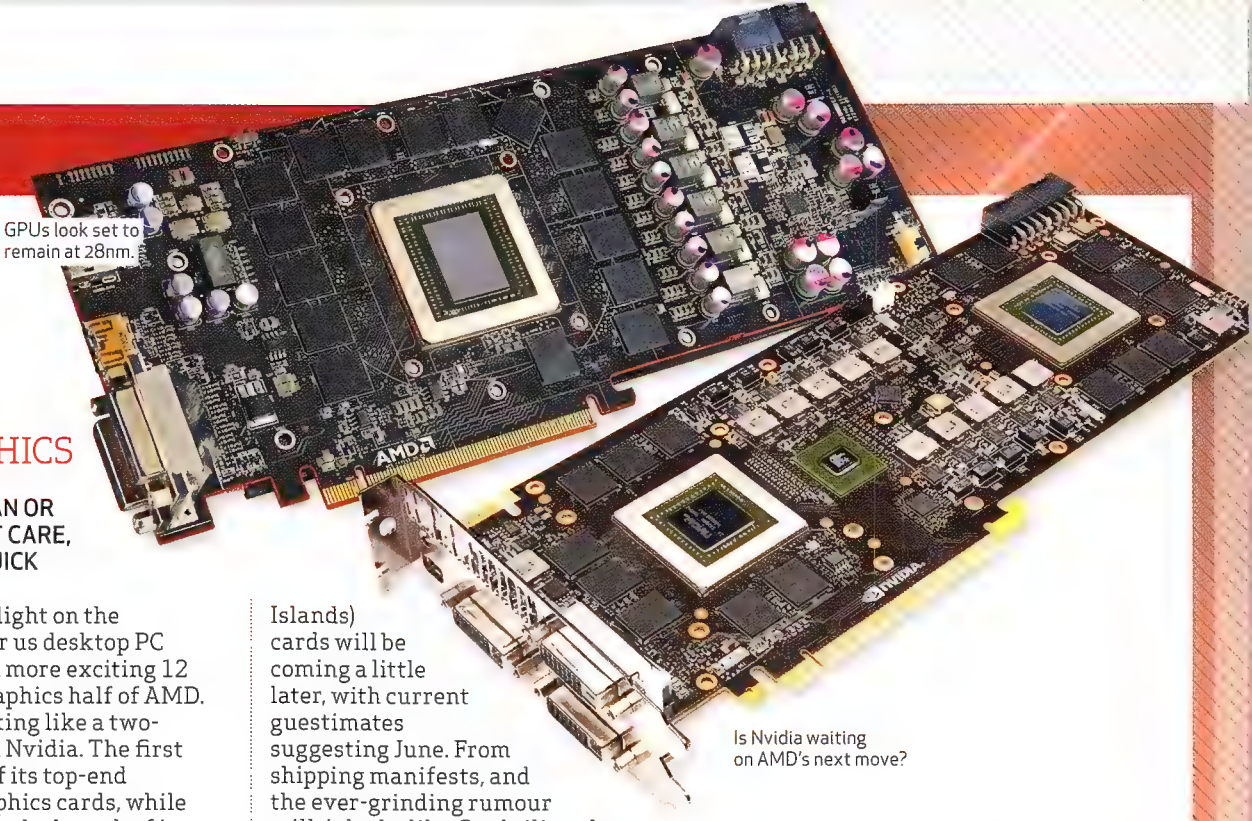
While AMD always seems to be in the midst of some sort of transition, its current shape is changing quite dramatically. From the appointment of Lisa Su as CEO last year, and the departure of John Byrne at the start of this year, AMD looks to be repositioning itself as a tech firm led by its engineers rather than its musketeers. Or marketeers. We forget which. One flounces around with over-stylised facial hair, dandified clothing and a reckless disregard for anything but themselves. The others are musketeers. Ha!

Tech-wise, the processor half of AMD is most definitely evolving, with 2015 being the intermediate year and 2016 set to introduce the real fruits of its current labours.

Or that is the ever-mutable plan anyways. The big push for mid-2015 will surround the release of its new Carrizo APUs, the follow-up to the Kaveri range launched at the start of last year. It introduces a new Excavator core and GPU component, plus will be the first full HSA 1.0 chip, the goal being to implement totally transparent hardware where apps can access any part of the tech directly and unfettered, whether that's CPU, GPU or memory components.

The Excavator core is the last hurrah of the outgoing Bulldozer architecture, and should give the Carrizo APUs a little performance boost, likely up to 10% in CPU terms. The GPU component is coming from the Tonga GPU of R9 285 fame. Sadly though, Carrizo is a resolutely mobile part, destined to never arrive on the desktop. Along with the low-power, Puma processor-toting Carrizo-L, AMD is looking to compete with Broadwell-U in the thin 'n' light laptop space.

This year is also set to see the rise of AMD's Project Skybridge, its ambidextrous platform set to provide a pin-compatible setup which will take either an x86 Puma+ based SoC or an ARM Cortex A57 with an integrated GCN-class GPU. Again though, we're talking about mobile parts – AMD desktop aficionados are going to have to wait until 2016 to get a bead on its high-end K12 Zen processors.



GPUs look set to remain at 28nm.

AMD GRAPHICS CARDS

HAWAII, CARIBBEAN OR PIRATE? WE DON'T CARE, JUST MAKE 'EM QUICK

If 2015 is looking light on the processor front for us desktop PC folk, it should be a more exciting 12 months for the graphics half of AMD. Its strategy is looking like a two-pronged attack on Nvidia. The first will be a refresh of its top-end Hawaii-based graphics cards, while the second will see the launch of its new Caribbean Island range.

The Hawaii refresh is likely to produce a small performance boost over the existing R9 290X, but will essentially be a mildly tweaked Hawaii core taking advantage of the matured manufacturing process allowing for more reliable, higher clockspeeds and potentially less heat. We were expecting this refresh at the tail end of 2014 in order for AMD to introduce some competition for the new Maxwell cards, but we're now expecting them before mid year instead. And given the refresh is now happening in 2015, it could be branded as an R9 380X instead.

The Caribbean Islands (née Pirate Islands) cards will be coming a little later, with current guestimates suggesting June. From shipping manifests, and the ever-grinding rumour mill, it looks like final silicon has started moving around the globe. It's likely then we're moving into mass production of AMD's next-gen GPU.

The rumoured specs for the purported Fiji XT GPU – the chip possibly powering the R9 390X – has it containing a mammoth 4,096 streaming processors with a 4GB frame buffer. That mightn't sound much, but the video memory should be the first release of a GPU with the high bandwidth memory (HBM) AMD has been working with Hynix to produce. HBM is similar to the 3D stacked memory in Samsung's latest SSDs, using TSV interconnects to boost bandwidth through the stacked video memory.

Is Nvidia waiting on AMD's next move?

That should give AMD's new GPUs huge bandwidth numbers, perhaps three times that of the GTX 980.

What's less clear is the production process. Given AMD's historically hot and power-hungry GCN GPUs, we were expecting AMD to need the 20nm lithography. But the purported prohibitively poor yields of high-end 20nm parts means we might not see any 20nm GPUs from either company. AMD has stated it's producing 28nm and 20nm parts this year, moving on to 16nm in 2016, and with the lighter transistor load of Carrizo being announced at 20nm, it looks like the GPUs will need to remain at 28nm.

NVIDIA GRAPHICS CARDS

THERE'S A TITAN WAITING IN THE DARK, READY TO POUNCE

This year is likely to be more of a reactive year for Nvidia in the graphics game. It's going to be busy enough though with its new mobile processing beast, the 256 CUDA-core'd Tegra X1. But that's not to say we won't see movement from the green team on desktop GPUs. We've already had the release of the middle order Maxwell GPU, with the GTX 960 rocking a new GM 206 GPU. That gets Nvidia's current generation to a state where it could have comfortably waited to see what AMD did before releasing anything else. It didn't, however, releasing the $1,500 Titan X last month and providing a new single-GPU target for AMD to aim for.

AMD's still set to drop its new R9 3xx series of cards sometime around the middle of this year. Once the full might of the R9 390X is known, Nvidia may release additional cards based around the Maxwell graphics architecture.

As with Kepler before it, we know that Maxwell isn't tapped out yet when it comes to consumer cards, and we'll likely see Nvidia drop in a more affordable high-end card in between the $700 GTX 980 and the $1,500 Titan X – it'll be named the GTX 980 Ti, if history is anything to go by.

MIGHTY MAXWELL

The K6000 was the top Nvidia Quadro running the GK 110 GPU that went on to feature in the GTX Titan, so this seems to make sense for a pro card with the top Maxwell GPU in it. The rumoured specs have the Quadro's GMPU running with 3,072 CUDA cores across 24 SMMs with an enormous 96 ROPs. An earlier SiSoft Sandra database entry detailed a 3,072-core card with 12GB of VRAM, which would seem to corroborate this story.

The subsequent Titan release (possibly a Titan X) will likely come with the same GPU configuration but probably a smaller frame buffer, perhaps the same 6GB that the existing Titan houses. But when the new ultra-enthusiast SKU of Nvidia's Maxwell architecture actually arrives really depends on when AMD releases its top Caribbean Islands, the R9 390X card.

It's all change in solid-state land this year.

SOLID-STATE DRIVES

GET READY FOR A BIG SSD FIGHT OVER NVME.

OK, this year looks like becoming a serious bunfight in the SSD world. Things have been shaken up entirely by the demands of the new NVMe standard to replace the existing AHCI protocols that rule both current SATA and M.2-based SSDs. That means 2015 will see a raft of new SSD controllers and all the usual suspects are involved – it's going to be fascinating watching how it all shakes out.

Samsung has already gotten its NVMe SSD controllers running in the enterprise world, so expect to see that roll out to its consumer drives later on this year. The SM951 is the M.2 NVMe set to replace the XP941 we've already tested and has recently gone into mass production. It's also PCIe 3.0 compatible, running over four lanes to offer sequential read and write speeds of a reported 2,150MB/s and 1,550MB/s respectively. That drops over PCIe 2.0, but still looks seriously quick.

Comeback kid OCZ is also prepping a new NVMe controller, called the JetExpress. Again it's PCIe 3.0 compatible across four lanes with potentially 10 NAND channels per controller chip. In the enterprise world, where the JetExpress will first hit, it's possible to double down on the controller chips to boost performance. Whether that will come down to the future consumer versions we don't yet know.

But OCZ-owner Toshiba hasn't been demonstrating the fruits of collaboration, instead using a new Marvell NVMe controller to make up the single package SSD it's been showing off at the start of the year. The unit Toshiba has been demonstrating packs 128GB of Toshiba NAND into a package with the controller to make a single-chip SSD that's smaller than an SD card.

That's likely to be the new 88NV1140 controller from Marvell, designed for small form factor mobile devices, but it's also started demonstrating its 88SS1093 controller designed for PCIe 3.0 M.2 drives running on NVMe protocols. Again, it will be a four-lane setup, backwards compatible with PCIe 2.0. This is probably going to be the most prevalent controller in a range of SSDs, with Crucial/Micron again likely to base its NVMe drives on Marvell.

But SandForce isn't dead and buried. It's coming back with the SF3700 which has been shown off in the upcoming ADATA SR1020 M.2 drive. It's another NVMe-capable controller, but the top-end SF3759 option only stretches up to four-lane PCIe 2.0 connections. Still, with those caveats the ADATA drive was hitting 1,800MB/s on both reads and writes. SandForce says it's also gotten around the incompressible data problems, shutting off its own compression algorithms when it comes to the tricky data sets.

MOBILE TECHNOLOGY

DESKTOP GPU POWER FOR TABLETS AND FULL DESKTOP CPUS AND GPUS FOR YOUR LAPTOP. BOOM!

From a mobile standpoint, Nvidia's latest SoC is probably the most exciting. The Tegra X1 is the Maxwell-powered successor to its Kepler-based Tegra K1 chip, and brings a pair of the same SMM modules you'll find in the GTX 980 into a 20nm SoC. That provides 256 CUDA cores and 16 ROPs in a mobile chip, which will deliver some serious graphics power. The chip has a 1GHz top clockspeed, which will allow it to deliver a full 1 TFLOP of graphical processing, though in tablet form factors it's unlikely to be able to sustain this speed for very long.

But because Nvidia had always been looking towards the mobile sector when designing Maxwell, the new TX1 is capable of bringing all that extra performance to bear with lower power demands. The next SHIELD Tablet could be an absolute beast.

AMD is focused on its own laptop chips in the form of Carrizo. As we've said earlier, it's the successor to Kaveri and brings the new Excavator cores and Tonga GPU to the mobile APU market. Whether it gets many design wins though is debatable, which is a shame given that it's likely to be very powerful, with potentially almost double the GPGPU performance of Iris Pro.

PUT A DOCK IN IT

We'll also see Broadwell and Skylake mobile chips this year, though likely only full quad-cores on the Broadwell side by mid year. Still, they'll be drop-in upgrades and we're seeing an interesting new trend emerging in laptops: the gaming dock.

MSI has recently shipped the GS30 with its Gaming Dock, offering a slimline i7/Iris Pro laptop with a x16 PCIe connection to a base dock. With extra storage, audio and support for full desktop PSUs and GPUs, the dock essentially turns your laptop into a desktop when you're at home.

But you can have desktop goodness in laptop form too. MSI's GT80 Titan has got a full mechanical switch keyboard while Clevo has created a design housing full desktop processors in a 4kg notebook. Scan and XMG, among others, have already signed up, looking to produce more customisation than the future BGA-only CPU designs will offer.

Say hello to your new desktop.

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MONITORS

WILL IT BE THE YEAR TO SPEND SOME MONEY ON A GAMING SCREEN?

Could this be the year the perfect gaming monitor arrives? Given the amount of progress over the last 12 months, we're hoping 2015 will bring us mighty close.

The big news will be around refresh rates. Oh yeah, sexy time. The most exciting part is we're not far from getting 120Hz/144Hz IPS gaming monitors on our desktops. ASUS's upcoming MG279Q isn't an RoG panel, but it's got serious gaming chops with its 27-inch IPS panel sporting both a 1440p resolution and a refresh rate up to 120Hz. Speaking with ASUS, it reckons the MG279Q might even get up to 144Hz if its engineers can get the electrics and panel to play nice together.

But what of GPU synchronisation? Well, this panel isn't a G-Sync panel, but it will support DisplayPort 1.2a, so it will support Adaptive-Sync and the compatible Radeon card will then be able to deliver FreeSync smoothness. Funs. And for AMD folk, 2015 will be the year of FreeSync.

ASUS's new gaming panel may not be FreeSync branded, but BenQ, Viewsonic, LG and Samsung are all releasing screens that are. It's a wide spread of screens, from 27-inch, 1080p, 144Hz panels, to 31.5-inch 4K screens at 60Hz.

PANEL BEATERS

But what of G-Sync? Well, Acer is set to make a splash with its 27-inch, 144Hz, G-Sync screen, mostly for the fact it's rocking an IPS panel. There's a possibility it's actually an AU Optronics AHVA panel, but they're almost indistinguishable from IPS screens anyways. ASUS is also fleshing out its G-Sync line with a 4K IPS screen rocking Nvidia's synching hardware, the RoG Swift PG27AQ.

And if you're already bored of 4K resolutions, LG is introducing its Z27q, a 27-inch panel with a 5,120 x 1,880 resolution. So, if you thought Windows scaling at 4K was bad...

Fancy potential refresh rates of up to 144Hz?

PERIPHERALS

MEMBRANE OR MECH SWITCH? THIS YEAR YOU MAY NEED TO CHOOSE.

Keyboards are probably going to show the biggest change in this coming year, with the inexorable rise of the mechanical switch looking to take over entirely. Not just content with jumping into the gaming laptop market with the crazy MSI GT80 Titan, the not-so-humble mechanical switch keyboard is trying to ape membrane switch boards on your desktop too.

SteelSeries is producing a board called the Apex M800 with a set of QS1 switches. These new switches aim to offer the performance of a linear mechanical switch with the feel of a membrane switch. So even if the clicky feel and tall key caps of mech switches puts you off, you'll still be able to get the accuracy and reliability with the same membrane smoothness. The M800 should be released in just a few months, though is likely to have a pretty hefty price tag attached.

But Cherry, the main mech-switch maker, is also working on a new switch. The Cherry RK, or RealKey, uses an analogue controller designed to offer a 1ms response time within the keyboard itself. Current switches rely on a digital controller to tell when a key has been pressed a single time, which Cherry has measured at a 20ms response. Another upshot of this is that ghosting isn't possible as every key produces its own analogue signal, so according to Cherry, ghosting "simply does not happen". It's only going to be available on the Cherry MX Board 6.0 as it isn't licensing the tech out just yet, so expect to see it around Q1 this year.

We'll also probably see advances in optical sensors, as they start to catch up with laser opticals in terms of speed, so gaming mice fans shouldn't feel too left out. And with Mad Catz promising the release of its RAT ProX they really shouldn't. Billed as the most future-proof mouse ever, the ProX is designed to allow different modules to be upgraded by the end user. We're used to the RATs being customisable, but being able to change the sensor itself is unprecedented. At launch there will be three different sensors available: Philips 2037, Avago 9800 and the Pixart 332WM10. You can choose whichever one you want at purchase, or buy upgrades at the Mad Catz store.

Yeah, RAT fans! Prepare for the "future-proof" ProX.

VIRTUAL REALITY

STRAP ON YOUR GOGGLES AND LOSE THE REST OF THE WORLD

The VR vanguard is no longer just Oculus.

One of the biggest changes in tech is that virtual reality has become an actual category of product rather than just a singular entity. Of course the Oculus Rift is still going strong in the vanguard of the latest VR revolution, but a number of other manufacturers have now thrown their helmets into the ring.

Several industry players have formed the Open Source Virtual Reality (OSVR) ecosystem, including Sixense, Razer and Leap Motion. Razer is going to be offering its OSVR Hacker Dev Kit in June. At $200, it has everything you need to get started, with a headtracker, display and optics all included. But with the onus being on open source-ness, you can already download the prototype's schematics and components list if you wanted to build your own device from scratch.

This isn't going to be about putting together some next-gen Oculus beater though, more about getting affordable VR into developers' hands so they can get on with giving us more involving worlds for us to get virtually obsessed with.

JOINING THE REVOLUTION

There are also rumours floating around that the long-awaited consumer version of the Oculus Rift (CV1) is being slated for release this winter. Details are still sketchy and nothing has been confirmed; indeed an interview with the UK's *Telegraph* has been altered to remove a section that purported to have CEO Palmer Luckey estimating a 'summer 2015' release of CV1. Oculus is also remaining tight-lipped about the resolution, meaning we may end up with the device displaying at 1080p, but using downsampling (such as Nvidia's Dynamic Super Resolution) to create a sharper image.

Inputs are going to be hugely integral to the success of this second coming of VR and Sixense is looking to be at the fore. Its STEM system is the evolution of its collaboration with Razer in designing the Hydra controller. It's wireless and uses magnetic fields to track movement. The setup looks incredible and is the sort of thing that will make or break VR. The initial three-tracker setup is more than the cost of a DK2 Oculus Rift though and is set to ship in May or June.

OPERATING SYSTEMS

MICROSOFT TAKES A HOP, SKIP AND A JUMP TO A NEW OS. HELL, IT'S A WHOLE NEW ECOSYSTEM...

Later this year we should see the final launch of Microsoft's next operating system. And to sweeten the deal, Microsoft is set to distribute Windows 10 gratis for the first 12 months for both Windows 8.1 users and Windows 7 folk. That last bit is important as it shows Microsoft is determined to pull the Win8 naysayers from their Win7 bolt holes.

Microsoft is also looking to create a unity between Windows 10 on the PC, phone and tablet. And also on the Xbox. Yes, you read that right. Xbox. With a new pre-loaded Xbox app for Windows, you'll be able to connect to an Xbox One and play your console games on any Windows 10 device. Of course, with our powerful gaming PCs, we'd be more interested in doing it the other way around, taking our games into the living room with the Xbox console, so hopefully that will also be made an option at some point.

Still, because MS is talking about streaming to any Windows 10 device, that means low-power laptops, tablets and phones too. That's the sort of unified setup that Microsoft has been chasing for years.

Taking that even further, with the release of DirectX 12, Xbox and PC gamers will be able to play together. The next *Fable*, *Fable Legends*, has been revealed as allowing Xbox and PC gamers to enjoy the game together. Whether that will be limited to co-op games or open to competitive multiplayer, CoD-style gaming too, is still unclear. The age-old problem of mouse-accuracy versus joypad sensitivity is always going to be a thorny subject.

And, as we've mentioned in the past, there is a Start menu for the new operating system – though with the new 'Continuum' system (the method for the OS to mold itself to whatever device it's running on) you can explode it to take over the whole screen for that Win 8 nostalgia. MS is also bringing its phone-y personal assistant, Cortana, to the desktop. With Windows 10 then you can have a personal relationship with your PC that people aren't going to think is really creepy. And our offices will be filled with people not just shouting at their computers, but having them shouting back too.

You'll be able to play Xbox One games on any Windows 10 device.

It certainly looks like Microsoft has learnt from the difficulties it had moving people to Windows 8, and Windows 10 could be the most inclusive, versatile and powerful OS we've ever seen on the PC. Poor Linux... ■

Jargon buster

Not sure what some terms mean? Here's a handy dictionary of what you need to know.

MOTHERBOARDS

CHIPSET > The combination of processor socket and interface chips that connect the CPU to the motherboard. Most system features are built into the CPU or the chipset, and so it defines performance and such things as SATA 6Gbps support for the rest of the PC.

ATX > A set of standards that define the size of a motherboard and the position of its fixings. Without this, there'd be no guarantee the motherboard would fit in your case or even have screwholes in the right place. Subsets include the smaller mini-ATX and micro-ATX, which sacrifice expansion slots for a smaller size.

PCI EXPRESS > The bus between the chipset and the expansion slots. The older PCI standard has now been phased out from most Intel motherboards. Bigger slots contain more lanes and are described as multiples – a standard graphics card requires a sixteen lane (16xPCI-E) slot.

PROCESSORS

SOCKET > How the processor is attached and then clipped firmly to the motherboard.

MANUFACTURING PROCESS > Measured by the size of components in an integrated chip, which are tiny – thousands of times smaller than the width of a hair.

HASWELL/HASWELL REFRESH > Internal codenames for Intel's fourth and fifth generation Core processors. We often refer to processors bytheir codenames in the pages of *APC*.

PILEDRIVER > AMD's architecture for their current FX processors. The A-series is based on the newer Kaveri (Steamroller) architecture.

RAM

DIMM > Dual In-line Memory Module, the long thin circuit boards which are used to mount RAM chips into your PC.

MHZ > Megahertz, a measure of clock speed, which governs all the data transfers in your PC by moving electrons round in sync with each other.

CAS > Column Access Strobe, the regular pulse which reads information from the columns of bits on a memory chip. The CAS latency is the number of clock cycles it takes to retrieve data from the array, so the lower the better.

MONITORS

CRT > Cathode Ray Tube. The old analogue screens, drawn on by the firing of internal electron guns.

LCD > Liquid Crystal Display. A monochrome layer of liquid crystals that block or allow light to pass through individual sites.

LED > Light Emitting Diode. Low power lighting used in newer LCD screens to reduce running costs.

DISPLAY RATIO > The length of a screen compared to its height. Common ratios are 4:3 (old fashioned CRT and iPad), 16:10 (PC widescreen, now rare), and 16:9 (widescreen TV sizes such as 720p and 1080p HD).

CASES

ATX> The size designation for a motherboard and case. Make sure both are the same or else they won't fit together properly.

5.25/3.5/2.5-INCH > The three standard sizes for internal drives. Optical drives are always the larger 5.25-inch design, while hard drives are usually 3.5-inch. Some cases now have fittings for laptop drives (2.5-inch) since that's the size of a common SSD.

SECC> Steel, Electroplated, Cold rolled, Coil. The most common material used in case design. It's the stuff that gives you static shocks while you build your PC.

SSDS

TRIM > Most modern OSs support TRIM, a feature of SSDs that instructs them to fully erase blocks of deleted data in the background when they aren't being used.

SATA 6GBPS > The most common specification for hard drive-to-motherboard interfaces is SATA 6Gbps, aka SATA III.

M.2 > A new specification for installing expansion cards, including next-generation SSDs.

WRITE LONGEVITY > All flash memory has a limited lifespan, and will wear out after a certain number of writes. Current SSDs have an MTBF (Mean Time Before Failure) of around 2,000,000 hours and are no more likely to fail than a normal hard drive would.

3D GRAPHICS CARDS

GM2XX > The code numbers for the microarchitectures used by Nvidia's current 900-series graphics. The GTX 970 uses the GM204 core, for example, while the Titan X is based on GM200.

PCI EXPRESS 3.0 > Newer motherboards and graphics cards support this. It's only important if you're running more than one graphics card, as it means you can have two 16 lane slots working at full speed at once.

IMAGE QUALITY > Settings such as shadows, high dynamic range, motion blur and high resolution textures that you can turn off to make games go faster.

CABLE GUIDE

FAN HEADERS > The CPU fan runs off the motherboard via this four-pin connector. Case fans can use similar, or plug directly into the PSU.

SATA CABLES > These transfer data between drives and the motherboard. The L-shaped fitting means they only go one way round.

SATA POWER > Similar in shape but larger in size to the data cable, these run from the power supply to the storage drives.

FRONT PANEL CONNECTORS > These thin connectors attach directly to upright pins on the motherboard. See your manual for the layout.

24-PIN ATX CABLE > The main power cable that plugs into the motherboard. The last four plugs are detachable for older 20-pin designs.

PCI-E CONNECTORS > Not to be confused with the eight- pin CPU power line, these six- or eight-pin fittings are clearly labelled for the GPU only. ■

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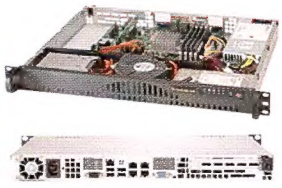

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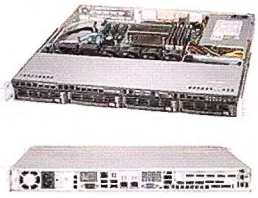

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- Up to 32GB DDR3 ECC 1600MHz UDIMMs in 4 slots
- 4x 3.5" Hot-swap SATA3 HDD Bays
- 1x PCI-E 3.0 x8 (in x16) Full-height Expansion Slot
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- 4x DDR3L 1333/1600MHz ECC UDIMM slots
- 12x 3.5" or 2.5" SATA fixed HDD/SSD bays
- 1x PCIe G3 x8 slot (x 8 signals) Slot
- 1x Intel® 82599ES 10Gb SFP+; 4x Intel® 82574L GbE RJ45
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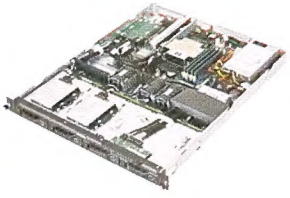

- 1x Intel® Xeon® E3-1200 v3 4th Generation Processor
- 4x DDR3L 1333/1600MHz ECC UDIMM slots
- 4x 3.5" or 2.5" hot-plug HDD/SSD bays + 2x fixed 2.5" bays
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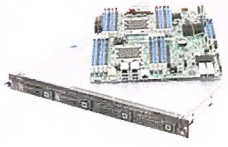

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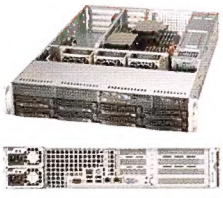

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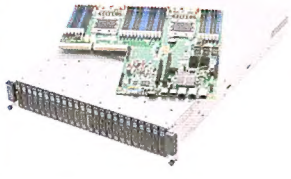

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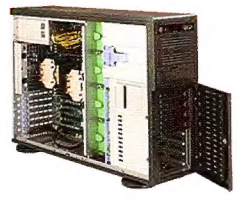

- 2x Intel® Xeon® Processor E5-2600/E5-2600 v3
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